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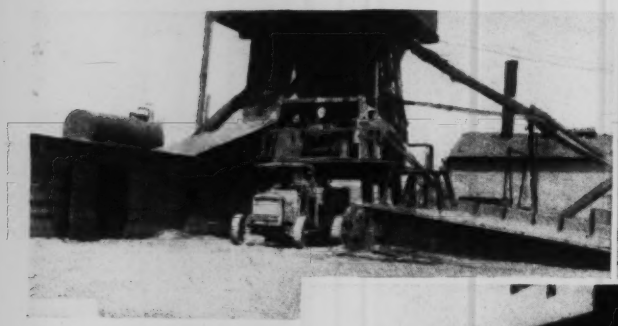
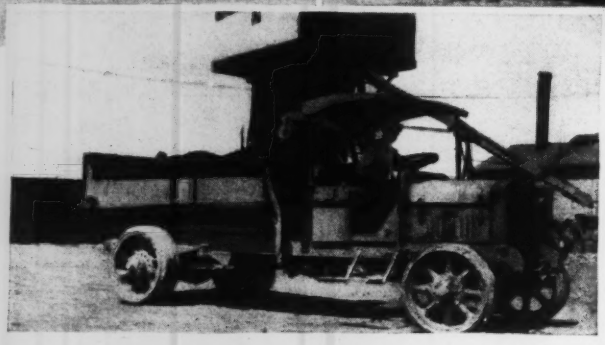
Operation of the Largest Activated-Sludge Sewage Disposal Plant at Houston, Texas—Underpinning the Terraces and Approaches to the Lincoln Memorial at Washington—Road Patrol Maintenance in North Carolina

From Job and Office—Hints That Cut Cost and Time for Contractor and Average Engineer

Sludge Settling Tanks in Operation at the Houston Activated-Sludge Sewage Disposal Plant

General Motors Trucks





These views illustrate the work done by the fleet of GMC trucks owned by the Pacific Construction Company of Phoenix, Ariz.

Haul Material for City Paving with GMC

Fully one-third of the paving done in Phoenix, Ariz., in the last eight years has been put into position by Messrs. W. S. Kent and David Jones, operating a contracting organization under the name of Pacific Construction Company.

Their fleet of three GMC trucks has handled all of the material entering into these contracts of the Pacific Construction Company with the City of Phoenix.

When asked as to their experience with GMC trucks in street paving and road building contract work, and their reason for the selection of GMC for this work, both Messrs. Kent and Jones expressed themselves similarly in this manner:—

"We were led to select GMC trucks for our work because pass experience of some fourteen years in this territory decided us that we were able to secure in them the same strength and quality found only in other trucks costing fully twice as much money. We had decided for GMC long before the formation of the Pacific Construction Company and before the time we entered the contracting field for ourselves.

We specialize in bitulithic pavement. This type of paving requires a much better hauling equipment than is the case with other types. The reason is that the materials have to be handled and hauled very hot. If the work is to be carried on during the heat of the summer months the motor equipment suffers much greater stress than if the material to be hauled were of the usual cool nature. We have found that operation under extreme conditions of heat does not mitigate against the efficiency of GMC trucks. They stand up to the work required of them regardless of temperature conditions.

"Further, haulage of materials is a most important factor in contracting for pavement of the type we furnish. The materials have to be handled twice. Once to our plant where they are mixed and heated, second to the work in progress. Naturally we are obliged to carefully compute every factor entering into this item in order to carry on our business profitably, because price competition is extremely keen in the paving field.

"Then again, because of the fact that the materials must be placed in position at the right temperature, it is essential that we be able to determine our schedule of delivery from the plant to the work with some degree of precision. This we are able to do with our GMC trucks because we know we can depend upon them to provide an uniform service at all times.

"Our GMC trucks have been in service since 1919. During that time we have kept them constantly employed upon our street paving contracts here in the city. They are subject to considerable rough travel. Bringing stone, sand and gravel from the pits to the treating plant has taken the trucks into the roughest sort of going.

"Our experience with GMC trucks has been such that we are glad to make the unqualified statement that all of our future purchases of truck equipment will be GMC. We do not believe we can say anything stronger."

GMC trucks are economical in first cost, too. Their chassis list prices, at the factory and plus the tax, are: one-ton, $1,295; two-ton, $2,375; three and one-half-ton, $3,600; five-ton, $3,950.

GENERAL MOTORS TRUCK COMPANY

Division of General Motors Corporation

PONTIAC, MICHIGAN

Dealers and Service in Most Communities

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, Editor

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A Way Out

AT LAST a road has been opened toward a solution of the German reparations tangle. The German government has agreed to submit to a minute and rigid supervision of its financial affairs by the Reparation Commission. On that basis there is hope for a moratorium and, given a moratorium, there is hope for the flotation of an external loan. During the past week there has developed also an inclination on the part of France and Great Britain to discuss without display of temperament the scaling down of reparations. All of which bids us hope and watch expectantly for further developments.

Russia and Capitalism

THE Hague conference has ended precisely as was foreshadowed when Secretary Hughes refused to participate in it. He declined to negotiate with a government that refuses to respect property rights or the obligations of contract, for on those rights and obligations only can industrial and commercial enterprise find a sure foundation. The European nations, more hopeful or more anxious, have attempted such negotiation and have failed. The Bolshevik rulers will have none of our capitalistic ideas. Just now, they are cocky and independent. Crops promise well and they can afford to wait. Meanwhile 8,500,000 Russians, the real victims of the Red supremacy, are kept alive by $59,500,000 of capitalistic gold poured into that stricken land by American charity. Capitalism may be anathema to the government of Russia, but her people owe their very existence to the triumph of capitalistic charity over self-interest.

"Taintor" or "Tainter"

FOR a number of years there has been used a type of dam crest gate of well-recognized design known variously as the "Taintor" and as the "Tainter" gate. The literature of the subject uses the two spellings indiscriminately, and there is not readily found any authoritative reference to the man from whom the name is taken. In the interests of uniformity, one spelling should be adopted even were it not due to the original designer to have his name spelled correctly. Can any engineer throw light on the right name of this man?

Getting Down to Cases

NOT the least valuable among the services the American Association of Engineers renders to its members is the work of its Practice Committee, which considers and reports on questions that involve the ethics of professional practice. Following the method of the American Institute of Consulting Engineers, its reports are published in the form of hypothetical problems with answers, although the cases they discuss are concrete and specific and concern actual practicing engineers and their clients. The whole procedure contrasts pleasantly with the fog of generalities that so often falls over a discussion of such questions by an engineering society. So far, more than forty cases have been reported, and the association proposes to compile these and edit them for more general circulation. It is hoped that by this means it may be possible to introduce the engineering student to a consideration of the ethics of his profession and that another step may be taken toward a code of practice that may eventually be of service to engineers in general. Both objects are worthy, and the effort deserves to succeed.

Design or Invention Again

ENGINEERS will be interested in Judge Dickinson's decision in the concrete chute patent case, outlined in the news pages, more as an indication of the trend of patent rulings than because of its effect on chute royalties. It is only a lower court case and is, in effect, in opposition to both the lower and upper court decisions in another circuit, so that it is by no means final in its application to the patent in question. The important part of the Dickinson decision is that once again the courts have emphasized how difficult it is in the construction field to distinguish design from invention. Rarely in that field does anyone discover anything fundamentally new; the best that can be hoped for is to combine old things in a new way. But after all that is what design is. So the courts have to fall back on the principle, reiterated in this case, that in such novel combinations invention lies only in the exact arrangement and amount of combination claimed. Those engineers who are tempted to patent their new ideas will do well to test out their value by this criterion.

Highway Footpaths

AT the next session of the New Jersey legislature the state highway commission will endeavor to secure an amendment to the state highway act which will provide for the construction of paths for pedestrians along state highway routes. Statistics are not needed—although plenty are available—to show that prompt measures should be taken to reduce the number of accidents which have followed in the wake of increased motor traffic. The rural highway, as built under present conditions in the United States, is designed and constructed solely for vehicle traffic. The pedestrian has received little, if any, consideration. Where the automobile driver and the man on foot must use the same traffic way, it is inevitable that the toll of accidents will be heavy. The action of the New Jersey Highway Commission, in its campaign for footpaths, should be followed by other state highway departments. The problem is not a new one. British highway engineers, for years, have included footpaths as an essential part of rural roads. In fact, this detail of British practice so impressed the editor of this

journal during his European trip in 1920 that he wrote (see *Engineering News-Record*, Aug. 5, 1920, p. 275) that "this construction and maintenance of footpaths is but one of the many evidences of a development far beyond our own." It was further pointed out in the letter just referred to that in British practice footpaths are generally of gravel and that a recent trend of practice is to tar-treat them. In two counties, Midlothian and Lancashire, there are many miles of tar-treated footpaths, with stone ranging from ¼ to ½ in. in size. Spraying in alternate years keeps the paths in good condition. In the light of New Jersey's plans, the adoption of footpaths along state roads in this country was accurately forecast two years ago, for the article previously quoted concludes with this sentence: "Before long some one [in the United States] will break the ice by building footpaths; their acceptance after that is likely to be rapid."

Wilmington Garbage Muddle Continues

WILMINGTON on the Delaware is again—or still—in a garbage muddle. A year or two ago the city council and health board got into a mess over a new garbage furnace which failed on test, the health board claimed, but which nevertheless, was promptly paid for by the city council—and immediately broke down. The contractor for the furnace claimed that it could not be expected to burn wet garbage, and for some months there was much local contention over the enactment and enforcement of an ordinance requiring all householders to drain their garbage and wrap it in paper. Now the contractor for garbage collection demands an increase in pay, partly because of the increase in volume of collections through the paper wrappings. Once more the council and health board are at loggerheads. The lesson is to put garbage collection and disposal, whether at Wilmington or elsewhere, in the sole administrative control of one department, under the immediate charge of an engineer experienced in this class of work. Whether collections should be made by the city direct instead of by contract is largely a matter of local expediency, with the consensus of competent opinion, based on both theory and experience, in favor of municipal rather than contract collection.

Trouble From Plastic Subsoil

CONTINUING settlement of foundations is fortunately a rare trouble, but when it happens it is apt to be costly and troublesome in the extreme. This is illustrated by the notorious West Side filter plant in Cleveland, and is another aspect by the Lincoln Memorial approaches, whose underpinning is described on p. 146 of this issue. The engineer gifted with the ability to foresee such settlement trouble will avoid many a grief, and, in so far as careful study of cases of trouble will develop this ability, it is therefore well worth while to scrutinize each new recorded instance. For this purpose the Lincoln Memorial case is of particular value, because it appears to involve plastic action of a relatively unstable subsoil. It adds to the number of cases in which a fill placed on river-bottom deposits has produced a slow squeezing of these deposits chargeable to plastic flow laterally rather than bodily compression. The instability or fluidity of the Potomac River mud has manifested itself on prior work in the valley, for example on some of the District of Columbia bridge work. There is enough parallelism between the behavior of a soil as a fill and its behavior as a subsoil to make it a safe, practical rule that a material which would be questioned for use as a filling material behind a retaining wall should also be considered with suspicion as a foundation or sub-foundation stratum. For either use, we know, a sharp grained material that will settle to a firm, solid condition is quite sure to be satisfactory, while river-bottom soils are common sources of trouble. It should not be difficult for the foundation engineer to check up the quality of foundation subsoils by the criterion of their suitability for wall filling, and thereby get better assurance of stable construction.

Sewage-Sludge Dewatering at Houston

THE latest report on sewage-sludge dewatering at Houston is promising. Had it not come in time to supplement the lengthy review of the operations of the two activated-sludge plants at Houston, published elsewhere in this issue, the outlook for sludge dewatering, as far as experience of Houston is concerned, would have been discouraging.

The cause for discouragement would have been due to the long train of difficulties encountered and apparently not overcome in 1921 at the Houston dewatering plant and to the high cost of pressing and drying the sludge. Mr. Fugate's supplementary note on dewatering tests thus far in 1922 indicates a heavy reduction in pressing costs by conditioning the sludge with sulphur dioxide (without steam) and by using a continuous roller press instead of a filter press. Details of this recent and promising work at Houston will be awaited eagerly by many.

Commendation and thanks are due to the engineering staff and all who have joined the latter in the long-continued and sometimes almost baffling work of adapting available sludge handling appliances to the idiosyncracies of the sludge from the activated process, and of devising new methods of treatment. How well deserved praise and thanks are will be more apparent when emphasis is placed on these facts: (1) Houston, as early as May, 1917, put in operation what is still by far the largest activated-sludge sewage-works in use; (2) that in January, 1918, the city let a contract for a dewatering-plant, designed to produce a commercial (10 per cent moisture) sludge; and that (3) all concerned have persisted through more than four years of effort to build the dewatering plant and get it into dependable operating condition at reasonable cost.

The difficulties incident to commercial sludge dewatering may be further illustrated by the long and varied series of experiments carried on by Mr. Hatton at Milwaukee, preparatory to a decision—not yet announced—on which to base the design of the proposed dewatering plant to handle the sludge from the activated-sludge works that is to treat the sewage of that large city.

That the sludge problem still remains the crux of sewage disposal except where plenty of land is available, is attested by the experiences at Houston and Milwaukee and by the tentative manner in which commercial sludge dewatering has been dealt with—or more generally postponed—by nearly all engineers who have been confronted with the problem in connection with activated-sludge plants in both America and England. Is it at least on the eve of solution? The question is not one of scepticism, but rather of caution and of hope.

A Question of Realism

PROGRESS in the field of engineering structures has consistently been directed toward more accurate definition of the attacking forces to which a structure is subjected and its resisting powers. In the primitive period of the art hardly more than intuitive perception was available to guide the planning of a new structure, while today loads are estimated very precisely, to approximate actual facts as closely as possible, and the structure is proportioned to carry these loads with only the necessary margin of safety. Essentially the change has been in the direction of realism, and the meaning of any step or proposed step in the field may be appraised on the basis of whether it tends in this same direction.

Simple as it appears, the problem involved in load determination is complicated and delicate, because—except in relatively few instances—the loads change from moment to moment, and their amount is beyond the control of the constructing engineer, so that in his design he actually has to enter into a forecast of what the future may bring. Most peculiarly complex, in this aspect, is load determination as it affects the design of railway structures, for this has to deal with progressive growth in traffic and motive-power conditions and therefore involves prediction, perhaps prophecy, in a way quite outside of mere probability calculations. The same general view, however, applies to this subject as was indicated just above, namely, that progress is to be measured in terms of approximation to physical fact.

It may not be generally realized that the loading for which railway bridges are designed is of a kind that does not exist. The heaviest actual train loads affect bridges in a different way from the standard loadings for which they are built. This has been true for quite a few years, and the subject has been repeatedly discussed by engineers with a view to changing to a more satisfactory condition. The Cooper loading system fitted the actual facts excellently for a number of years after its adoption in the '90s, but changes in railway practice soon brought it out of harmony with fact; the divergence between the two has increased until the old load system is no longer safe to use without various arbitrary adjustments, different for each case.

Engineering discussion of this subject in the past has given evidence of a widespread desire to get back to actual fact, if it is possible to determine what the facts as to present and future loading really are. Yet the discussions have remained without positive conclusion except more or less enthusiastic reapproval of the Cooper system. Opportunity is now at hand for a new examination of the question by a discussion within the American Society of Civil Engineers based on a noteworthy analysis presented in a paper by D. B. Steinman. Through a study of the heaviest locomotives and trains used on American railways, and of their effect upon bridges, Dr. Steinman has obtained numerous actual figures showing the discrepancy between the strength results given by the old loading system and the strength required for modern traffic. He has also set up and analyzed several new loading systems which approximate the facts much more closely than the Cooper system.

The discussion opens up not merely the question of this or that wheel load system, however, but the more fundamental question of whether bridge analysis by wheel loads is desirable at all. Wheel-load calculation has been practiced almost universally for three or four decades, in spite of the fact that it is more complex in its handling than calculation on the basis of distributed loads. Its use rests on the very appealing argument that it is a direct representation of actual fact: that cars and locomotives rest on bridges by means of their wheels, and that by using the wheel load and wheel spacings the actual state of affairs on the bridge is transferred to the designer's fundamental calculation sheets.

In the face of this apparently convincing argument the wheel-load system has been applied only in fragmentary manner. The wheel loads of the locomotive and tender have been used for the calculation, but the train wheel loads have not. If this was originally due to the belief that the loads per wheel on freight cars were so small that their action as concentrated loads might be ignored, as compared with that of the engine concentrations, traffic developments have long ago made this view inapplicable, for the heaviest railway cars now have load concentrations not far below those of the locomotive, and, as the spacing of the car wheels is greater than that of the engine wheels, the argument for maintaining the distinction between concentrated and uniform load is greater for the train than for the engine.

Apart from this one phase of the question, however, certain other facts enter in. First, the railway engineer generally takes account of an outward spread of roadbed loads, downward from the rail head, by assuming several ties to distribute the concentrated effect of a wheel. In the case of bridges he omits this step, but it is quite likely that the load effect as it reaches the structural members of a bridge corresponds more nearly to that of a distributed load than to that of a concentrated load. Moreover, inequality of loading which results either from the construction of a locomotive or from conditions developing in its framework or in the track, may frequently produce a difference between the actual locomotive effect and the assumed ideal concentrated-load effect as great as any that would be introduced by the assumption of distributed loading.

Most important, perhaps, is consideration of the fact that wheel spacing and wheel arrangement change from one engine to the next, so that the theoretical beauty of exact correspondence between the real engine and the ideal of the bridge loading diagram can never be maintained for more than an instant. From a sufficiently distant viewpoint, it ought to be immaterial whether a train is hauled by this or by that locomotive, of the same general weight and motive-power effect; the railway mechanical man takes the same view, and we are half inclined to think that the bridge engineer should do likewise, on the ground that the action upon the bridge itself is not very different, present beliefs to the contrary notwithstanding.

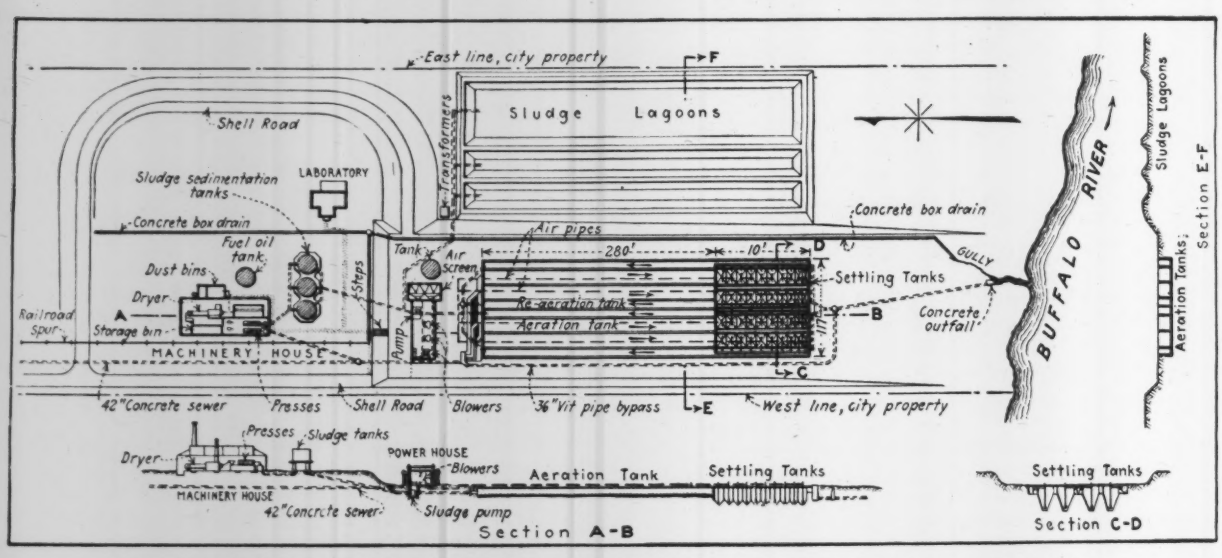
There are reasons, to put the matter briefly, for giving unprejudiced reconsideration to the question of whether it is necessary, or wise, to continue the apparent refinement of wheel-load calculation in bridge practice. The occasion of the paper noted above enables this question to be discussed in detail, and gives opportunity for an important and lasting addition to the bridge engineer's art.

Operation and Dewatering at Largest Activated-Sludge Plants at Houston, Texas

Ten- and Five-M.G.D. Sewage-Works—Filtros Plate Cleaning and Resetting—Operating Curves and Costs for 1920 and 1921—Sludge Dewatering Plant and Acid Conditioning Tests

WHAT is still the largest activated-sludge plant in the world was put in use by the city of Houston, Tex., in May, 1917. It has a capacity of 10 m.g.d. On Aug. 10, 1918, a unit of half the size to serve the remainder of the city began service. Both plants have been operated successfully since, with sludge disposal by lagooning. In October, 1917, small-scale experiments on treating the sludge with soda ash and sulphuric acid were begun, but the results were not sufficiently promising to warrant the adoption of the process. In January, 1918, a contract was let for a dewatering plant to treat all the sludge from the north-side or larger plant by (1) further sedimentation, (2) pressing and (3) drying, so it could be sold after pulverizing as a fertilizer base. Various obstacles delayed completing this plant and putting it into operation until January, 1921, and during 1921 so many difficulties were met that the dewatering plant, although run on a working-scale basis, was not operated at full capacity. Besides testing the presses, conveyors and dryer on a working scale, the 1917 experiments on sludge conditioning were resumed in 1921, using sulphuric acid in one set of tests and sulphur dioxide and steam in another. Final conclusions on sludge conditioning not having been reached at the close of 1921 it was decided to extend the experiments into 1922. (See supplementary note at the end of this article stating that on July 8 it was believed that the dewatering problem had been solved and that the dewatering plant, with the use of sulphuric dioxide gas, and without steam, and with a continuous roller press would go into continuous full-time operation.—EDITOR.) Through the courtesy of J. C. McVea, city engineer of Houston, and G. L. Fugate, principal assistant engineer, we are enabled to present herewith many data from descriptions of the Houston activated-sludge plants, a general review of their operation to the close of the year named and more detailed facts and figures for the years 1920 and 1921 prepared by Mr. Fugate for Mr. McVea's 1921 annual report.

It should be noted that the investigations leading to the adoption of the activated-sludge process for Houston and the designs of the two plants were made by E. E. Sands, city engineer of Houston before Mr. McVea assumed that office. The larger or north-side plant was described by C. L. Williford, an assistant engineer of Houston, in *Engineering News-Record*, Feb. 8, 1917, p. 236; a staff article on operating experiments based on a visit to Houston, appeared Dec. 11-18, 1919, p. 1,103; and a reproduction of the forms used for records, Jan. 8, 1920, p. 75.

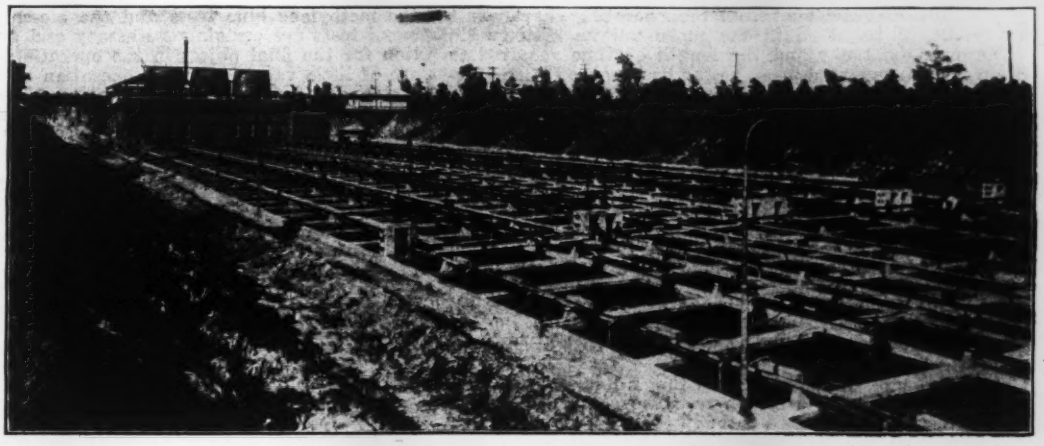


LAYOUT AND SECTIONS OF ACTIVATION, SETTLING AND RE-AERATING TANKS, POWER HOUSE AND DEWATERING PLANT

Houston had a population of 78,800 in 1910 and 138,276 in 1920. In the latter year, 14,420 premises had connections with the sewers and there were about 15,000 "box closets," cesspools and small septic tanks. It was estimated that 100,000 of the population had sewer connections. Night soil collections are dumped into the sewers. In general, the sewers are on the separate plan, with storm-water overflows because of illegal roof connections and manhole perforations.

Pumping and Preliminary Treatment—The sewage treated at each plant has first been pumped and then passed through outfall sewers. Before pumping the sewage flows through bar screens spaced 1 in. in the clear, while in addition that going to the north-side or larger plant passes through a grit chamber at a ve-

locity of 23 ft. a minute. The screenings in 1921 averaged 3½ cu.ft. per million gallons of sewage at the main pumping plant delivering sewage to the north-side or larger works and 2.9 cu.ft. from the sewage going to the other works. Some of the screenings are burned in a garbage incinerator and some are used for filling and then covered with ashes from the incinerator. There is no record of the material removed from the grit chamber.



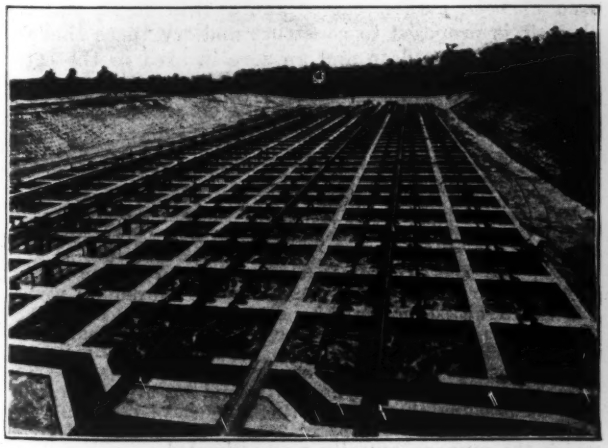
GENERAL VIEW: POWER HOUSE IN DISTANCE WITH DEWATERING PLANT ABOVE AND BEYOND

The Two Works—Each of the four 25-m.g.d. units of the north-side plant consists of one aerating channel, 18 x 280 ft. in plan with an area of 5,040 sq.ft.; 10 settling tanks, 10 ft. x 18 ft. 10 in. in plan, with combined top area of 1,883 sq.ft., a sloping bottom, and a depth of 22 ft.; and one re-aerating channel 9 x 280 ft., with an area of 2,520 sq.ft. In each aerating unit there are 1,050 filtros plates, the ratio of plate to surface area being 1 to 7 and the depth of sewage over the plates being 9.75 ft. The air is supplied by Sturtevant blowers, which have a volumetric efficiency of 71 per cent under best conditions, while the overall efficiency of motors and blowers is 50.5 per cent.

Filtros Plates: Removing Iron Rust and Resetting in Concrete.—The filtros plates are 12 in. sq. and 1½ in. thick, grade S, General Filtration Co. make. Originally the plates were set in cast-iron holders, secured at the north-side or larger plant with sulphur and at the other plant (built later) with cement grout. Iron rust from these holders clogged the plates so badly after a few months use that an average of only 1.3 cu.ft. per minute could be passed through each plate under an operating pressure of 11.5 in. of mercury, while some of the plates were completely clogged. The method of removing and cleaning these plates (smashing and scrapping the cast-iron holders; immersing the plates in a 10 per cent solution of hydrochloric acid; re-setting them with cement grout in concrete holders) was described in these pages, Dec. 11-18, 1919, p. 1,003, while the work at the larger plant was in progress, but the report under abstract contains more complete data. About 25 per cent of the filtros plates at the larger plant were ruined, since, being set in sulphur, it was necessary to break the iron to get the plates free. At the smaller plant, where cement grout was used instead of sulphur, it was possible to chip away the joints by means of an air chipping machine and only 1 per cent of the plates were broken. Plates that broke into only two pieces were made usable again by sealing the break with cement grout. The plate resetting, including the new holders, cost $1,500 a unit at each plant. Three of the four units at the larger and one of the two units at the smaller plant have had the plates overhauled.

Effect of Dust on Filtros Plate—Although the concrete holders seem to have virtually stopped rust-clogging (the velocity of the air through the pipes is so low that it carries to the plates very little of the rust which forms in the pipes) there is still apprehension as to the filtros plates becoming clogged. In fact, local clogging takes place and causes trouble, as the following extract from the report shows:

The cleaned plates have now been in use almost two



AERATING TANKS WITH AIR-SUPPLY PIPING

SLUDGE SETTLING TANKS WITH SLUDGE AIR-LIFT

years and show much more clogging than is evident from the pressure diagram shown on the operating chart. This can especially be noted in the more uneven distribution of air over the tanks and the length of time required to obtain normal pressure after power has been off. Considerable power trouble has been experienced in the past six months; during the month of September (1921) the power was off nine times. Check valves are not provided in discharge lines, consequently when power is cut the blowers are reversed by the uneven pressure, thus creating a partial vacuum in the air lines. This causes sludge to settle in a compact mass over the plates and creates more top clogging than ordinary sedimentation would create.

It is proposed to install check valves to prevent vacuum forming, and also to design a machine to grind off about ¼ in. from the top of the plates. It is believed that this will prolong the life of the plates at least one year. When it becomes necessary to replace with new plates the air lines should be thoroughly cleaned of any rust and an air washer installed.

The location of the plant is such that a minimum amount of dust is held in the atmosphere. The air before reaching the blowers is screened through 8-oz. duck with a total area of 750 sq. ft. Tests show that this does not remove small particles of dust and is effective only for screening out large particles and insects which would otherwise be drawn into the blowers and transmitted to the air distributing system. These tests were run by inserting canton flannel discs in the 2-in. supply pipes. The discs would become so badly clogged with fine matter in about two weeks that the air supply would be practically cut off. The dust collected was high in carbon.

One plate was placed in an individual holder and used for nine months in one of the aeration tanks. This was removed, carefully dried, and broken. A dark discoloration was evident for about one-fourth the distance through the plate from the bottom side, similar to clogging material caught on the flannel discs. About ¼ in. on the top showed considerable clogging from sludge. The coarse matter collected in the holder under the plate weighed 4¼ grams, 21 per cent of which was volatile.

The general operating results in 1920 and 1921 for the north-side or larger plant are shown by the accompanying diagram. [The smaller plant, Mr. Fugate states, has given good results, with not a single sample of effluent showing less than 99 per cent relative stability, and with the effluent containing more dissolved oxygen than is necessary to satisfy the five-day biochemical demand. The volume of sewage treated is way below the full capacity of the plant.—EDITOR.]

Relative Value of Chemical Analyses—Under this head the report says:

The composition of the raw sewage with an increment of increase in strength is fairly constant and tests need be run only occasionally as a check, except that the tests for nitrogen as free ammonia, bio-chemical oxygen demand and suspended solids should be run each day.

The test for free ammonia is one of the most important tests for controlling the operation of the plant. The free ammonia of the effluent varies widely, depending upon the sludge condition. If the sludge is in the best condition there will be only 2 to 5 p.p.m. and it is desirable to keep the value below 10 p.p.m. There are also rather sharp changes in the amount of free ammonia which are without explanation, and very often if the operation is continued in exactly the same manner, the ammonia will come back to a low value.

The test for nitrites is a fairly good indication of the condition of the effluent. In the best working conditions the nitrite value is very low. The test is easy to make and may be taken each day with very little trouble.

The nitrate test is, if anything, more important than the free ammonia test. It has been noticed that in the very best condition of the sludge the value of the nitrate should be about 40 per cent of the value of the free ammonia in the raw. It is desirable to keep the value above 2 p.p.m. The effluent usually has good stability if the value of the nitrates is above 2 and the value of free ammonia below 10.

The oxygen consumed test is not considered of any value in the operation of the plant and will be discontinued this year. The test for suspended solids is of more value as a matter of record and in making certain computations.

As a final analysis the relative stability records both by the methylene blue tests and the bio-chemical oxygen demand tests are certainly necessary and give a good indication for the final object in the operation of the plant, but are of little value in control operation as the time required is too great for immediate results. The sludge changes very quickly and the tests for free ammonia and nitrates give the results at once and if necessary a change in operation can be made.

The increase in the strength of the sewage during the past two years, as measured by suspended solids, free ammonia and by bio-chemical oxygen demand, and by the screenings, is attributed by Mr. Fugate to an increase in night soil collection and a decrease in both per capita water consumed and ground water infiltration, the latter because of the dry year.

Construction and Operating Costs—The cost of each activated-sludge plant not including land or the $82,787 paid for the north-side dewatering equipment, together with a summary of 1921 operating costs, is shown by Table I.

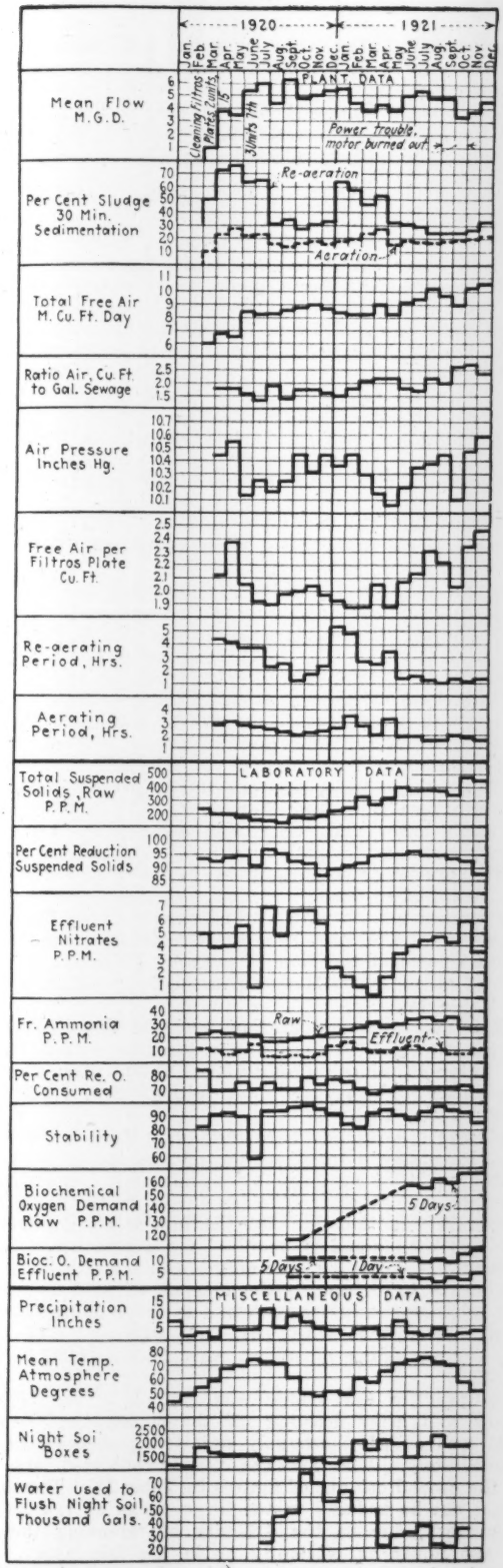
TABLE I. CONSTRUCTION AND 1921 OPERATING COSTS FOR HOUSTON ACTIVATED SLUDGE PLANTS

	North Side	South Side
Construction Cost*		
Excavation	$25,822	$6,361
General contract	194,405	87,789
Crane	1,125	1,125
Motor and blowers	7,245	6,199
150-hp. Diesel engine	7,646	
Sludge pump and motors	526	525
Wayne oil tank	86	43
Concrete fuel oil tank	1,200	
Well		1,350
Elevated steel tank		1,917
Water pump and motor		373
Filtros plates	6,439	3,219
Miscellaneous	82	18
Total	$244,576	$108,919
Engineering and incidentals	10,095*	7,656*
Grand total	$254,671	$116,575
Cost per m.g.d. cap.:		
Without engineering, etc.	$24,475	$21,784
With engineering, etc.	25,467*	23,315*
Operating cost in 1921:		
Monthly salaries	$6,938	$5,297
Weekly salaries	4,223	2,172
Power	11,134	2,535
Supplies and maintenance	3,813	366
Total	$26,108	$10,370
Cost per m.g. treated	$16.30	$15.20

* From the article in *Engineering News-Record*, Dec. 11-18, 1919, p. 1003, based on notes obtained at Houston, the preceding November by a member of the editorial staff of that Journal, it appears that the construction cost figures include no allowances for 50 acres of land bought by the city at the north-side and 15 at the south-side works, of which only some three acres is used for works purposes in each case. The items for engineering and incidentals have been taken from the article named above, as they are not included in the report on which this article is based.

Sludge Lagooning—At both plants the sludge has been satisfactorily lagooned, without creating any nuisance, Mr. Fugate states. Deep lagoons have been used at both plants, but at the south-side or smaller plant it is proposed to construct and try three shallow ones, about 2 ft. deep and an acre in area in the hope that the material will dry "sufficiently to be hauled away by farmers." As to the quantity of sludge produced, Mr. Fugate states that measurements have not been possible (it is hoped that they may be in the future). He submits the following estimate:

By taking the number of hours the sludge pump was run in November and December, 1921, using an estimated capacity for the pump and the average moisture in the sludge, and checking against the quantity of suspended solids in the raw sewage, the result for November would indicate a digestion of 54.8 per cent and for December. 48.6 per cent. Using the average solids in suspension for the year 1921, a quantity of 1,518 lb. of 10 per cent moisture sludge per million gallons sewage is derived. However, it is believed that these figures should be used with caution as possibly the pump rating may have been in error due to changing conditions between the observations from which the average capacity was estimated.


1920
1921
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
PLANT DATA
Mean Flow M.G.D.
Cleaning Filtros Plate Units
3 Units 7th
Power trouble, motor burned out
Per Cent Sludge 30 Min. Sedimentation
Re-aeration
Aeration
Total Free Air M. Cu. Ft. Day
Ratio Air, Cu. Ft. to Gal. Sewage
Air Pressure Inches Hg.
Free Air per Filtros Plate Cu. Ft.
Re-aerating Period, Hrs.
Aerating Period, Hrs.
LABORATORY DATA
Total Suspended Solids, Raw P. P. M.
Per Cent Reduction Suspended Solids
Effluent Nitrates P. P. M.
Fr. Ammonia P. P. M.
Raw
Effluent
Per Cent Re. O. Consumed
Stability
Biochemical Oxygen Demand Raw P. P. M.
5 Days
Bioc. O. Demand Effluent P. P. M.
5 Days
1 Day
MISCELLANEOUS DATA
Precipitation Inches
Mean Temp. Atmosphere Degrees
Night Soil Boxes
Water used to Flush Night Soil, Thousand Gals.

OPERATING RESULTS BY MONTHS IN 1920 AND 1921 AT HOUSTON 10-M.G.D. ACTIVATED-SLUDGE PLANT

The amount of digestion in the lagoons, Mr. Fugate thinks, is indicated by the difference in the volatile matter of the fresh and the lagooned sludge, as shown by Table II. The character of the lagoon effluent may be judged from Table III.

TABLE II. ANALYSIS OF FRESH ACTIVATED SLUDGE AND OF SLUDGE FROM LAGOON EDGE, NOV. 26, TO DEC. 4, 1917

	Fresh Activated, Per Cent	From Lagoon Edge, Per Cent
Volatile	70.12	55.42
Fixed	29.89	44.58
Fats (ether soluble, dry basis)	9.28	9.51
Ammonia (dry basis)	5.58	3.95
Phosphonic acid (total, P_2O_5)	1.45	1.29

TABLE III. ANALYSIS OF SLUDGE LAGOON EFFLUENT, DEC. 13, 1917

	P. P. M.
Free ammonia — nitrogen	92.00
Nitrites — nitrogen	00.05
Nitrates — nitrogen	00.40
Organic — nitrogen	12.00
Suspended solids, volatile	50.00
Suspended solids, fixed	16.00

Early Tests of Sludge Acidification—The sludge conditioning tests to be described later were preceded in October, 1917, by tests with soda ash, sulphuric acid and heat, "along the lines of the so-called flotation process." Sludge from the re-aeration channel was settled one hour in 50-gal. barrels, the supernatant liquid siphoned off, the settled sludge heated to the desired temperature in galvanized-iron tubs over an open fire, and soda ash added and stirred to effect a complete solution. The sludge was then transferred to a barrel fitted with a valve at the bottom, the acid added with stirring and the contents allowed to separate for various lengths of time.

In this process (1) the acidification of the soda ash (sodium carbonate) frees large volumes of carbon dioxide which are entrained in the sludge and reduce its specific gravity; (2) the excess of acid over that required to neutralize the soda ash produces a chemical and physical effect upon the sludge. The soda ash used contained 58 per cent of sodium carbonate and the sulphuric acid had a specific gravity of 66 deg. Bé.

The tests showed that the best results were obtained with 105 lb. soda ash and 268 lb. sulphuric acid per ton of dry sludge at a temperature of not less than 45 deg. (113 deg. F.) . At and above this temperature the acid changed "the color of the sludge from an olive to a light brown, apparently causing it to floc in large aggregates," while the "water separated more quickly than from the untreated sludge."

Acidulation increased the percentage of ether-soluble fats from 12.91 to 14.19 and of nitrogen from 6.59 to 6.82. "The fats obtained were liquid and dark brown, in appearance like crude petroleum or heavy lubricating oil," so poor a product as to make fat recovery by this method not feasible. As to this dehydration process as a whole it was concluded that it "would not be successful, but may have some merit as a conditioner before some other final method." With chemicals in the amounts stated just above, and at a price of $3.60 per 100 lb. for soda ash and $22 per ton for sulphuric acid, the soda ash-sulphuric acid-heat method of sludge treatment would cost $6.70 per ton of dried sludge, with no allowance for heat, labor and capital charges.

Sludge Dewatering Presses and Driers—Mr. Fugate's description of the plant installed at the north-side or larger works to produce a commercially marketable sludge, the difficulties met and apparently not yet wholly

overcome in operation, and the tests on sludge conditioning with (1) sulphuric acid and (2) sulphur dioxide gas and steam is given in full below, and is supplemented by an important statement written by Mr. Fugate on July 8, all as follows: [Side heads here and elsewhere inserted by the editor.]

Early in 1918, a contract was entered into with the Simplex Ejector Co. of Chicago to furnish rams, presses and compressors, and with the Buckeye Dryer Co., Columbus, Ohio, to furnish a rotary dryer, conveyors and elevators, the object of this equipment being to dehydrate the sludge to a moisture content of not over 10 per cent, the resulting material to be used as a nitrogenous base for fertilizer. Due to the unsettled conditions brought about by the war and the period immediately following its close, the entire equipment was not furnished until in December, 1920.

First Stage: Further Sedimentation of Sludge—In this process of dehydrating the sludge, the first stage is to pump the sludge from the re-aerating channel to three 50,000-gal. cypress sedimentation tanks supported by a concrete platform about 16 ft. above the surface of the ground, the maximum head against which the pump works being 50 ft. This pump is a specially designed Worthington, 5-in. double suction, horizontal, split case, bronze impeller volute pump, 500 gal. per minute capacity, direct-connected wth flexible coupling to a 10-h.p. General Electric 220-volt, 1,200-r.p.m. motor, set on an extended base.

Considerable trouble has been experienced with the stoppage of this pump by small sticks, matches and fibrous materials, but this has been partly overcome by inserting cutting blades in the casing around which the impellers revolve.

The sludge as it comes from the re-aeration channel contains 99.6 per cent moisture. This is reduced by sedimentation in the cypress tanks to 98 to 99 per cent, depending upon the condition of the sludge and time settled. The tanks are supplied with a pipe grid aerator, so that sludge can be aerated during the pressing time, and also with piping for drawing off the supernatant liquid.

Second Stage: Filter Pressing—In the second stage, the settled sludge flows by gravity to two 500-gal. Simplex rams, or ejectors, where a varying pressure passes the sludge to the filter press. A maximum pressure of 140 lb. has been used, but apparently there is but little advantage gained by using a pressure of over 110 lb. There are two Simplex filter presses, each having 120 33x33-in. center-feed plates, designed for cake 1 in. thick. The solids are retained upon the filter cloths, while the filtrate is returned to the aeration tanks. The air pressure for operating the press is furnished by two Gardner horizontal two-stage 8x4x6-in. compressors, maximum pressure 250 lb., speed 300 r.p.m., belt-connected to a 20-hp. slip ring, 220-volt, 3-phase, 60-cycle Ideal motor, speed 1,140 r.p.m. After pressing the cake is dumped upon an inclined platform and raked into a storage bin fitted with twin-screw conveyors; by these conveyors it is delivered to the feed end of the dryer where the third stage of dehydration takes place.

Third Stage: Heat Drying, Followed by Pulverizing—The dryer is a Buckeye type A, 5 ft. in diameter and 40 ft. long, known as a direct-indirect heat rotary dryer. The heat is produced in an oil burning furnace which is fitted with a relief stack. The dryer complete has all necessary elevating, conveying and transmission machinery to deliver the dried sludge from the dryer to the pulverizer, storage bins and railroad cars. A conveyor is also installed to pass cake that is not sufficiently dried back from the discharge to the feed end for redrying. The best results are obtained usually by passing back a small quantity of dried material, mixed with the wet, thus making the cake handle better through the conveyors and dryer. The vapors are exhausted by a No. 60 Garden City fan, speed 430 r.p.m. The vapors pass through a baffled dust chamber fitted with a water spray condensor.

A line shaft, speed 300 r.p.m., driven by a 40-hp. General Electric, 2,200-volt, 3-phase, 60-cycle motor, drives the fan for the vapor chamber, screens and all elevating and conveying machinery, also the fuel oil pump. A counter shaft belted to the dryer and a Williams Pulverizer is driven by a 25-hp., 2,200-volt, 3-phase, 60-cycle, Allis-Chalmers motor.

The construction cost of the dehydrating plant was: Building, $22,980; presses, $29,945; dryers, $21,353; tanks, $1,993; motors, $826; railroad spur, $5,689; total, exclusive of land, $82,787.

Operating Problems and Conditioning Experiments—In January, 1921, the plant was put into operation. At once various problems began to arise, and instead of the process being simple it was found to be very complex. With no precedent for a guide, the decision was reached to operate the plant on large-scale experiments with a small crew of operators and not attempt the full operation until the trouble was found and remedied if possible.

The experiments have included the full dehydration of sludge in all conditions likely to be encountered in ordinary operation of the plant. The conditioning of sludge by acidification with sulphuric acid and also with sulphur dioxide gas mixed with steam has been tried and a careful comparison with unconditioned sludge has been made.

Filter Cloth Troubles—The presses as received from the manufacturers were fitted with radial ribs in the cake chamber. Drier cake could be obtained with these ribs, but the wear on the clothes made their use prohibitive. During a number of pressings 50 per cent of the cloths would be ruined for further use, even with first-run cloths. Without the ribs the cloths last better but tear around the edges. This is a mechanical fault of the press that has not been overcome. Most of the pressings have been made with 11-oz. duck, but several materials have been tried. The 11-oz. duck gives the best rate of filtration, but hose cloth lasts longer. A specially imported jute cloth has been tried, also several grades of burlap. The life of these is greater than duck, but the filtration rate is much lower and the sludge adheres in larger quantities, making the cloths more difficult to launder. The cloths are most important in pressing and one of the big items of expense.

Pressing results with unconditioned sludge have varied between wide limits. The lowest moisture content of cake was 85 per cent and time of pressing 3¼ hours. The average of all pressings is shown in the first column of figures in Table IV.

The maximum evaporation made in any one run was at the rate of 1,751 lb. of water per hour with a 15.2 ratio of water to oil containing 19,000 B.t.u. The average of the three highest runs was: evaporation, 1,722 lb. per hour; ratio, 12.8.

Sludge Conditioned with Sulphuric Acid—It was found that by adding a small amount of acid to the sludge more water could be removed by sedimentation, pressing time reduced, and a better cake obtained. In the early experiments it was thought that the less water to be filtered the less time would be required for a pressing. However, this was found to be true only within certain limits. Experiments to determine the amount of acid required for the minimum moisture with one to three hours sedimentation showed that with 0.01, 0.02, 0.03 and 0.04 of acid the corresponding moistures were 98.71, 97.96, 98.43 and 98.72.

In practice the sludge was settled in the 50,000-gal. tanks and after drawing off the supernatant liquid the acid was added, thoroughly agitated, and pressing begun immediately. The average results obtained are shown in the second column of figures in Table IV. The moisture could not be reduced in the large tanks as low as in the laboratory, due to the difficulty of removing the supernatant liquid as efficiently as in the laboratory.

This shows that considerable advantage is gained in pressing by using acid, but is partly lost in drying. It has been observed that acidified sludge when introduced into the dryer has a marked tendency to roll up in balls

TABLE IV. PRESSING RESULTS AT THE HOUSTON ACTIVATED-SLUDGE PLANT WITH UNCONDITIONED AND WITH CONDITIONED SLUDGE

	Unconditioned	Conditioned With Sulphuric Acid*	Conditioned With Sulphur Dioxide Gas and Steam†
Moisture of sludge, %	98.48	98.70	98.88
Moisture of cake, %	87.37	82.64	85.58
Volume of sludge required to press, gal.	5,850	10,400	11,900
Cloths broken per pressing, no.	14	10	28
Av. maximum pressure, lb.	106	110	99
Av. pressing time, hr. and min.	4-42	3-20	3-30
Av. quantity of cake per press, lb.	3,280	3,390	3,108
Cake produced of volume of press, %	72.2	75.4	70.7
Quantity of dried sludge per pressing, lb.	335	392	448
Ammonia in dried sludge, %	3.6	4.6	4.6
Sludge lost during drying, %	19.5	33.0	2.2‡
Ratio of evaporation, water to oil	9	6.2	5.8
Evaporation per hour, lb.	1,250	1,025	850
Volumetric efficiency of entire process, %**	58.7	50.2	69.9

* Using 0.01% of acid.

† Using 102 lb. of sulphur and 925 lb. of fuel oil per pressing.

‡ Mr. Fugate states by letter that the number of runs made with sulphur dioxide gas and steam was relatively low—*Editor.*

** Percentage of final dried sludge to the theoretical volume that should be produced per press. "Dried sludge" means the final product of the dewatering process.

of different sizes, ranging from that of a small pea to several inches in diameter. As the drying advances the sludge reacts differently according to its character. It may break into flaky particles or form small balls with a hard, smooth surface. The latter condition is found to prevail with a sludge of a relatively large fat content, say between 9 and 12½ per cent. The untreated sludge after drying contains about 3.5 per cent of fats.

The reason for better dehydrating qualities of raw cake, as compared with acidified sludge cake, lies probably in the fact that the addition of sulphuric acid raises the fat content of the cake, and that the coagulated colloidal matter gives up its moisture less readily; also that the presence of any free sulphuric acid with its low volatility would retard the drying process.

Advantages and Disadvantages of Acid Conditioning—The advantages of using acid are in the lower moisture content of the cake, less time to press, and the increased nitrogen content; also the cake keeps better and dries with less odor. Odors, however, are not offensive if the cake is dried immediately after pressing.

The disadvantages are the lower evaporation ratio, a greater loss in drying, the drying process more difficult to control, more or less personal danger in handling the acid, the probable deteriorating effect upon the plant, and the increased fat content. About 10 per cent of the dry sludge is collected as dust from the dust room, and this amount seems to be the same with either unconditioned or conditioned sludge.

In the experiments described, the acid was applied to the total quantity of sludge to be pressed. A period of three or four hours would elapse from the beginning of the pressing to the close, during the latter part of which the sludge had a tendency to become alkaline. Equipment is being installed to apply the acid to each charge of sludge just before reaching the press and to use the hydrogen-ion concentration as control. It is believed that much better results may be obtained this way, as the sludge will reach the filter immediately after being acidified, thus doing away with the time element in pressing; also drying immediately after pressing may increase the drying efficiency.

Sludge Conditioned with Sulphur Dioxide Gas and Steam—In co-operation with the MacLachlan Reduction Process Co. of New York City, experiments have been made by gassing the sludge with sulphur dioxide mixed with steam immediately before pressing. (See last column of Table IV. for comparative results.)

Advantages and Disadvantages—The disadvantages of this method are: The bad effects of the sulphur fumes upon the operators, cost of oil used for producing the steam, and the low rate and ratio of evaporation. But there seem to be certain advantages and it is expected to continue the experiments with the view of eliminating the undesirable features mentioned. Based on these experiments, a comparison of costs of the different methods has been made showing the probable cost to operate the present plant. (See Table V.) [The figures have been combined in a single table for ease of comparison, as also some of the other figures given in this article.—Editor.]

Sludge Tests in 1922: Sulphur Dioxide Gas Without Steam and Continuous Roller Press Believed to Have Solved Dewatering Problem and Reduced Pressing Cost from $40 to $5 per Ton of Dry Sludge—A letter from Mr. Fugate, dated July 8, contains the following significant conclusions as to the results of the 1922 dewatering tests.—EDITOR:

The experiments with sulphur dioxide gas, which we have carried into 1922, are giving most promising results. The process, which has been developed in co-operation with the MacLachlan Reduction Process Co., consists of gassing the raw sludge without the use of steam, the gas being transmitted from the generator by a positive presser blower, and the gassed sludge passing through a continuous roller press, giving to date a cake of 78 per cent uniform moisture. The operation being continuous, there is no laundering of filter cloths. This method also does away with expensive delays which were experienced with the plate filter press. We are sure that we can produce cake of 78 per cent moisture for about $5 a ton, dry basis, thus reducing the pressing costs from about $40 to $5 a ton.

We now feel that our dewatering plant will be put in continuous full-time operation and the dewatering problem satisfactorily solved, and hope to have within the next thirty days or so a report giving complete details.

TABLE V. COMPARATIVE COST OF DEHYDRATING ACTIVATED-SLUDGE FROM RE-AERATION TANKS—(1) RAW; (2) CONDITIONED WITH SULPHURIC ACID; (3) CONDITIONED WITH SULPHUR DIOXIDE GAS AND STEAM

	Raw Sludge—422 Tons per Year		Sulphuric Acid Gas — 706 Tons Sludge per Year		Sulphuric Acid Gas — With Evaporation Ratio of 12 and Rate of 1,535 Lb. per Hr.*		Sulphur Dioxide Gas and Steam — 810 Tons Sludge per Year†		Sulphur Dioxide Gas and Steam — 600 Tons Sludge per Year‡	
	Pressing	Drying	Pressing	Drying	Pressing	Drying	Pressing	Drying	Pressing	Drying
Superintendence	$4.45	$4.45	$2.70	$2.70	$1.50	$1.50	$2.35	$2.35	$3.15	$3.15
Labor	13.55	9.60	8.10	8.90	4.55	5.00	10.20	7.80	11.20	12.95
Power	3.70	1.45	2.30	1.30	1.25	.70	1.95	1.20	1.60	1.50
Filter cloths	8.50	....	5.10	....	2.85	....	4.45	....	6.00	....
Repairing filter cloths	4.20	....	5.10	....	2.85	....	5.30	....	2.60	....
Laundering filter cloths	2.40	....	1.45	....	.80	....	1.25	....	Included in labor item above	
Sulphuric acid	....	....	8.50	....	4.70	....	....	....	....	....
Sulphur	....	....	....	....	....	....	4.60	....	4.60	....
Fuel oil	....	9.20	....	11.00	....	5.10	11.60	10.05	11.60	10.15
Miscellaneous	1.20	1.20	.85	.85	.40	.40	.60	.60	.85	.85
Totals	$38.00	$25.90	$34.10	$24.75	$18.90	$12.70	$42.30	$22.00	$41.60	$28.60
Total cost per ton	$63.90		$58.85		$31.60		$64.30		$70.20	
Probable wholesale value	12.60		16.80		16.80		16.80		16.80	
Net cost	51.30		42.05		14.80		47.50		53.40	
Net cost, retail value	$38.90		$33.85		$6.60		$39.30		$45.20	

* Individual runs produced results that warrant the introduction of cost figures on this basis. † Assuming dryer can be forced to 1,135 lb. evaporation per hour.

‡ Assuming 850 lb. evaporated per hour.

All the cost figures, with the exception to be noted are based on the following rates paid in 1921 for salaries, wages and power at the pumping station and disposal plants: Operators, $145 to $160 per month; laborers, $3.75 to $4 per 8-hr. day (some of the labor estimates in the table are based on a rate of 35c. per hour); power, 0.6c. per kilowatt-hour.

FROM JOB AND OFFICE

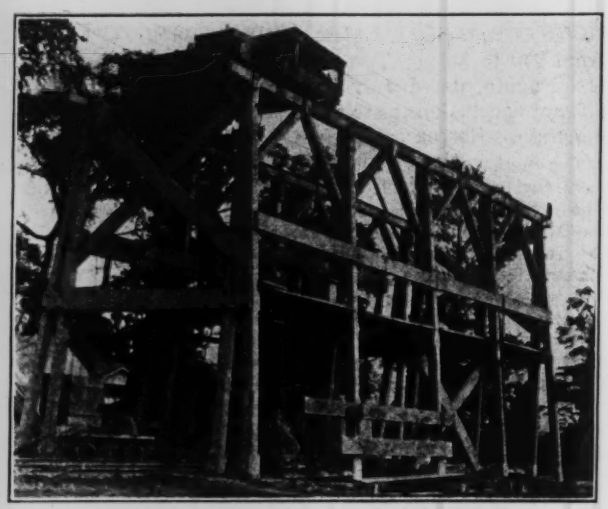
Hints That Cut Costs and Time — *For Contractor and Average Engineer*

Traveling Bridge Crane Used to Handle Sewer Construction Materials

BY J. H. MCGINN
Detroit, Mich.

A TRAVELING bridge crane of the type commonly used in machine shops, is being successfully used for handling material into and out of sewer tunnel shafts in Detroit, Mich. Being electrically operated, there is with this equipment a freedom from smoke and noise which is much appreciated by residents along the work. With the headframing put together, for quick dismantling, the outfit is also easy to shift with the frequent changes of shaft location required on small sewers with short drifts.

The headframe centered over the tunnel shaft is built of 6 x 6-in. timbers, is 18 ft. high and has a span of 10 ft. between rails. The bents are 8 ft. apart.



BRIDGE CRANE ON SHAFT HEADFRAME

Each upright is stiffened with a 6 x 6-in. batter timber offset 1 ft. 6 in. on the sill and mortised in at the top. All joints are mortised and bolted together. The operating platform is 7 ft. above the ground sills. The rail timbers are held by scab plates and supported at the centers of bays by 4 x 6-in. knee braces.

The trolley, which is of a standard design built by the Whiting Corp., Harvey, Ill., is equipped with two 3-phase, 60-cycle, a.c. General Electric motors. The hoist motor has a lifting speed of 165 ft. per minute, and the horizontal travel speed is 150 ft. per minute. Both motors are controlled and operated from the floor by pendant hand chains attached to trolleys. The 3-ton capacity hoist drum is equipped with two separate cables winding simultaneously on the drum, giving a direct lift and eliminating all pulley blocks.

With its hoist and travel motions the crane takes the dirt from the bottom of the shaft and dumps it into trucks, which back in under the operator's platform. It also easily handles all material from the ground level to the shaft bottom. A chain fastened to the trolley frame is hooked into rings in the center of the bottom edge of the spoil boxes and by lowering away on the hoist motor the spoil boxes are made self-dumping. One man operates the crane and dumps all spoil boxes. Ease of erection and dismantling is secured by means of an A-frame of 8 x 8-in. timbers, 22 ft. high, which fasten alongside of four of the uprights of the crane frame and are cross-braced parallel to the sides of the crane, but not transversely, and have a head piece bolted on top. By means of chain falls the electric trolley is lifted from the rails; a section of the rails and supporting timbers is then removed and the trolley is lowered to a truck for moving.

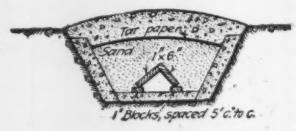
This crane equipment was developed by Raymond A. Mercier, Detroit, Mich., on whose sewer contracts it has been in successful use for some time.

Culvert Form Is Made of Sand

BY H. K. PALMER
Engineer, U. S. Indian Irrigation Service, Los Angeles, Cal.

IN BUILDING a concrete-lined ditch on the Fort Independence Indian Reservation, Cal., it was found necessary to cover about 40 ft. to provide a passageway for sheep. The ditch has a bottom width of 18 in., is 12 in. deep and has side slopes of ½:1, making the top width 30 in. On account of the small size a wood form for the cover would be difficult to remove, and one of sheet metal which could be left in place proved too expensive, on account of the high cost of material in this out-of-the-way location. The method adopted is shown on the drawing.

An inverted trough made of two 1 x 6's was laid in the bottom of the ditch, but raised off the bottom by means of 1-in. blocks spaced about every 5 ft. This was covered with sand to near the top of the ditch and the sand was compacted and shaped to form the centering for an arch. A sheet of building paper laid on top of the sand prevented any water from washing cement out of the concrete, and completed the form.



SAND FORM FOR SMALL DITCHES

After the concrete has set the sand was removed by turning a stream of water through the inverted trough. The trough being raised on blocks gave the water a chance to undermine the sand and in a few moments to carry all of it, with the trough, out from under the top. The grade of the ditch was about 2 per cent and the whole form was removed in four minutes.

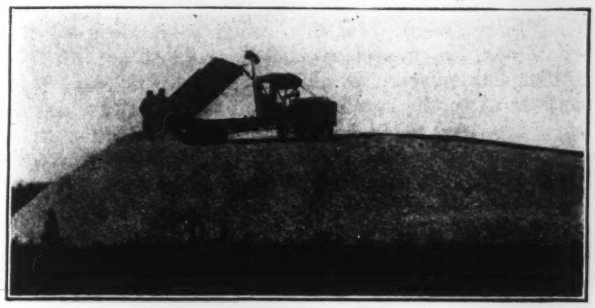
In another instance where the culvert was shorter but the ditch had a much smaller grade it took a little longer, but every time it has been tried it has worked so successfully that the method has been made a standard for building bridges or culverts across small ditches.

High Stockpiles Built Up with Heavy Trucks

By H. B. Jay
Superintendent of Construction, Illinois Division of Highways, Cobden, Ill.

BY MEANS of portable runways, a very satisfactory method of stockpiling road materials with heavy trucks was devised by the writer and is in use south of Carbondale, Ill., on day-labor construction. Runways in 10-ft. units are used. They are so constructed that all are interchangeable and are of such weight that two men can handle one unit.

Each runway unit consists of two 4 x 4-in. timbers laid parallel on 12-in. centers to which are spiked 2 x



TRUCK BUILDING HIGH STOCKPILE

12 x 16-in. planks, the ends of the planks being flush with the 4 x 4-in. timbers. On top of these planks, at the outside edge of the runway, a 4 x 4-in. timber is bolted to act as a guide for the truck wheels. The units are fastened end to end by means of ¾-in. hooks and eyes, and are fastened together laterally by the same method except that these hooks are of a length to give the proper gage of track.

Care must be taken that the runways are supported in their entire length by the stockpile material, as they are not designed to act as bridges. They are easily

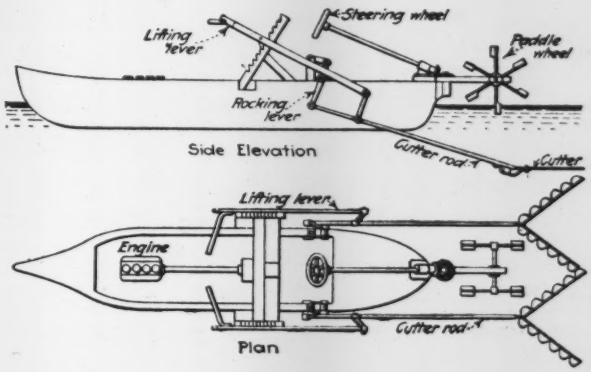
TIMBER TRACK FOR TRUCKS PILING CRUSHED STONE

and quickly assembled, and as easily taken apart and installed at a different stockpile. By them crushed stone is being stocked in piles 100 ft. long and 15 ft. high, and the piles could easily be made higher if necessary. Even though the weight of the loaded trucks averages 18,000 lb., no difficulty is experienced with the runways sliding, tipping up, or moving out of line.

Weed-Cutter for Canals and Lakes

AN ENGLISH device for clearing rushes, water lilies, weeds and other growth from drainage and irrigation ditches, rivers, lakes and ornamental waters consists of power-driven cutters operated from a small motor boat of 12-in. draft. Each cutter consists of a steel blade V-shaped in plan with a wavy or scalloped cutting edge and having the apex attached to a long rod. There is a rod on each side of the boat, as shown in the accompanying drawing, the upper end being attached to a rocker arm and also to a link on a lifting lever by which the cutter is raised and lowered as desired. The rocker mechanism is driven from the launch engine and as the boat moves forward the cutters are given a rapid oscillating motion, so that they engage the weeds at high velocity and strike them with a diagonal cut.

In shallow water the cutters trail on the bottom, being provided with spring shoes to keep them out of the mud and to guide them over logs or other obstructions. In deeper water they are set usually to cut at a depth of 4 to 6 ft. It is stated that in ordinary service the boat will clear as much as four acres in an hour. A small double paddle wheel is used for propulsion as



POWER DRIVEN WEED-CUTTER ON MOTOR BOAT

it will not be clogged with the weeds. This wheel serves also as a rudder, being carried by a pivoted frame which has a radial movement in a horizontal plane. For small ditches, a rowboat or a scow pulled by tow lines may be fitted with a single hand-power cutter, the oscillating mechanism of which is operated by a crank handle.

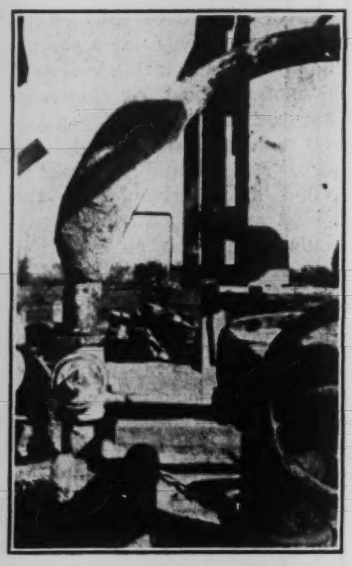
This weed-cutting device has been used extensively in England and also in India, Egypt and Australia. It is built by the Saunderson Tractor & Implement Co., Bedford, England.

A Record in Pile Driving

With a 3,200-lb. drop hammer and a crew of nine men, the W. S. Randle & Son Co. drove 138 pine piles averaging about 51 ft. in length in 10 hours, in Norfolk Harbor, Virginia. The piles were hoisted from the water, hauled 1,000 ft. and delivered to the driver as they were driven. The points and buts had not been previously made. To drive this number of piles, amounting to a total of 7,004 ft., or 1.32 miles, of timber, necessitated the handling of one stick every 4.3 minutes during the entire ten hours. This time includes that which was required for moving the driver.

Concrete Takes Sand Blast Abrasion in Bend of Ejector Pipe

A 4-in. pipe used in the construction of the Sacramento filtration plant for blowing sand out of a tunnel under air pressure of 80 lb. per square inch, was subjected to excessive wear at bends. Steel pipe of ordinary thickness wore out in about two weeks. After some experiment a patch made of rich concrete reinforced with wire mesh was put over the points where wear occurred, making the patch of generous proportions and extending it entirely around the pipe, as shown in the accompanying illustration. When the work shut down this bend had been in service for a month without giving any outward indication of wear.



CONCRETE PATCH OUTWEARS STEEL PIPE

Time Saved by Arrangement of Time and Pay-Roll Forms

By W. N. Connor
Aberthaw Construction Co., Boston, Mass.

IN CONSTRUCTION accounting all forms which are used together should be, as far as possible, similarly ruled and of the same size. In the practice of the Aberthaw Construction Co. the timekeeper's field sheet on which the men's numbers and hours are shown is ruled and numbered identically with the pay-roll sheet. When transferring the time each day from the timekeeper's field sheet to the pay-roll it is only necessary to place them so that the lines coincide, and then copy the time from the right-hand column of the time sheet to the adjacent pay-roll column.

Another help is to have the employees' numbers shown on the extreme right of the pay-roll. This expedites paying off and lessens the chances of error. The pay clerk need only look from the amount column to the number column—a distance of less than three inches. When the numbers are shown on the extreme left, which is usually the case, and the amount at the extreme right, it slows up the paying and offers a greater chance of error.

Ventilators for Concrete Reservoir Roof

When waterproofing is applied in concrete reservoirs that are roofed over with concrete, difficulties of the work are greatly increased by the lack of ventilators to provide a means of escape for the dense smoke that arises from tar or asphaltic compounds. According to contractors who do this work, means for quick ventilation would reduce the time and cost of waterproofing.

FROM JOB AND OFFICE

Hints That Cut and Time

Worn-Out Sheet Asphalt Pavement Renewed by Surface Treatment

By R. D. Budd
City Engineer, Petersburg, Va.

HAVING had considerable success in the treatment of sand-clay and gravel roads with liquid asphalt by building up from year to year an asphalt mat surface an inch or more in thickness, which has withstood moderately heavy road traffic, it occurred to us that worn-out sheet asphalt pavements might be benefited by such treatment. Inquiry failed to disclose where such a surface treatment had been tried out on old sheet asphalt pavements, and replies were more or less skeptical as to the success of such treatment for sheet asphalt. It was decided, however, to make this experiment, and we are entirely satisfied with the results. The street which was treated during the early part of 1921 was originally constructed in 1901. Since that time it has continuously been subjected to a very heavy traffic.

The material applied in this treatment was Texaco asphalt—with the following physical characteristics: Gravity, Beaumé, 16 to 19; loss after heating 5 hours @ 325° F., 25 per cent; asphaltic content of 100 penetration, 60 per cent.

Method Employed—The street was first cleaned and traffic excluded. The asphalt cement was heated in an open kettle to a temperature from 105 to 115 deg. F. and applied to the pavement in buckets by pouring and spreading with brooms. Dry sand was then spread to a thickness of ½ in. and the pavement rolled with a 10-ton roller and thrown open to traffic.

The rolling, we now believe, is unnecessary. Only about half of this work was rolled, and there is no difference in the appearance of the two types of work. The first street was covered with sand dried in an asphalt plant and applied hot; the balance of the work was covered with cold sand dried in the sun. We can see no difference between the work covered with heated sand and that dried in the sun. The amount of asphalt applied was approximately 0.2 gal. per square yard, and was all that could be held on the surface of the pavement without running into the gutters; the surplus was broomed ahead on the untreated work. The sand used for covering the work was retained on a 50-mesh screen, passed a ¼-in. mesh screen, and had been washed free of organic matter.

The work was done by a foreman and four laborers, none of whom had any experience in asphalt construction. The cost of the treatment was 7½c. per yard for labor and materials. The results have been entirely satisfactory. A ¼-in. wearing surface has been added to the thickness of the pavement, and what is more important, the old pavement has been revivified to its former elasticity. By occasional treatments we believe that we can maintain this street in its present condition.

Within the next year it is planned to surface-treat about 25,000 yd. of sheet asphalt pavement substantially as outlined above.

FROM JOB AND OFFICE

For Contractor and Average Engineer

How to Figure Grade Compensation for Metric Curves

BY C. K. CONARD
Northport, N. Y.

IN THE use of the metric system on railroad work there are certain formulas that, having origin in the English system, may cause confusion. We are prone to use "rule-of-thumb" methods, and sometimes fall into error through failure to consider the origin of a rule.

Take, for instance, curvature compensation. We are so accustomed to arriving at the grade correction by multiplying the degree of curve by the compensation constant, 0.03, 0.04 or whatever figure has been decided on, that we forget that the underlying principle is really to give to each degree of central angle the allowance of 0.03 or 0.04 of a foot, to be deducted from the total rise of the grade. We grow to think of the compensation as a rate of grade.

Now apply this rule of thumb in the metric system. The first inclination is to multiply the degree of curve by the accustomed compensation. Twice the writer has seen this tried. The first time *he* had to wrestle with the obvious error. The second time he was able to laugh at the other fellow. If you think the matter simple, before reading further work out the proper compensation for a 5-deg. metric curve, using 0.03 ft. for the rate of compensation. After reducing 0.03 ft. to the metric equivalent you *may* remember that the metric curve has five times as many degrees of central angle, per one hundred units of distance, as the English system. Anyhow, you will have done some thinking.

TABLE OF GRADE COMPENSATIONS FOR METRIC CURVES

	Compensations					
	For 0.03 Ft. Per Deg. Use 0.01 Meter		For 0.035 Ft. Per Deg. Use 0.011 Meter		For 0.04 Ft. Per Deg. Use 0.012 Meter	
Deg. of Curve	Per Deg. of Curve	Per Deg. Of Central Angle	Per Deg. Of Curve	Per Deg. Of Central Angle	Per Deg. Of Curve	Per Deg. Of Central Angle
1	0.05	0.01	0.055	0.011	0.06	0.012
2	0.10	0.02	0.110	0.022	0.12	0.024
3	0.15	0.03	0.165	0.033	0.18	0.036
4	0.20	0.04	0.220	0.044	0.24	0.048
5	0.25	0.05	0.275	0.055	0.30	0.060
6	0.30	0.06	0.330	0.066	0.36	0.072
7	0.35	0.07	0.385	0.077	0.42	0.084
8	0.40	0.08	0.440	0.088	0.48	0.096
9	0.45	0.09	0.495	0.099	0.54	0.108
10	0.50	0.10	0.550	0.110	0.60	0.120
11	0.55	0.11	0.605	0.121	0.66	0.132
12	0.60	0.12	0.660	0.132	0.72	0.144
13	0.65	0.13	0.715	0.143	0.78	0.156
14	0.70	0.14	0.770	0.154	0.84	0.168
15	0.75	0.15	0.825	0.165	0.90	0.180
16	0.80	0.16	0.880	0.176	0.96	0.192

It simmers down to this:

For the metric system, to figure a compensated rate of grade, multiply the degree of curve by five, and the product by the metric equivalent of the compensation per degree of central angle, and deduct the result from the rate of grade used on tangents. Or, $G_1 = G - (D \times 5 \times C)$, in which G_1 equals the compensated rate of grade; G = grade on tangents; D = degree of curve; and C = compensation in metric system, per degree of central angle.

It should be borne in mind that in the metric system there are two ways of referring to compensation. This is due to the unfortunate use of an unwieldly unit. The extreme length of a hundred-meter chain having led to the adoption of 20 meters as the chord length in figuring degree of curve, the simplicity of the metric system fails. In speaking of compensation, therefore, we have to define whether the compensation is per degree of curve, or per degree of central angle. The former is of course five times the latter. It is almost as awkward as the Englishman's method of referring to grades as a rise of one in sixty, or one in eighty, etc. The American civil engineer does not often realize how fortunate he is, with his decimal system that allows the office use of a scale one unit long, and the field use of a measure one hundred times this unit.

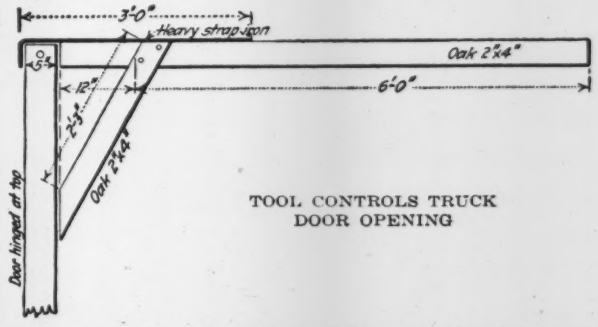
While it seems an unnecessary refinement to use many decimal places for working out rates of grade, there is one certain advantage. That is in checking up long compensated grades. Instead of checking each grade, from curve point to curve point separately, it is much shorter to work out the total rise as obtained by multiplying the total distance by the rate of grade on tangents, and from this deduct the product of the sum of the central angles of the curves, multiplied by the compensation per degree. The remainder gives the difference of elevation of the two ends of the grade.

This method may be used where spirals are employed by making the compensation extend from the down-hill point of spiral to the up-hill end of the regular curve. That is, the length between these points equals the length of a regular curve of the same total central angle.

The following table of compensations has been worked out for metric curves, giving values for 0.03, 0.035 and 0.04 feet per degree. These are the rates most commonly used. The metric equivalents of these rates are sufficiently close for practice.

Job-Made Tool Controls Truck Door For Spreading Stone

A TOOL made of two oak scantling, a piece of strap iron and a few spikes is used successfully in holding truck doors open the proper width to spread crushed stone or gravel for road construction in Virginia. As indicated by the sketch the strap iron is hooked over the top of the end door and the short arm of the lever bears against the rear side of the door so that an operator on the long arm of the lever can hold the door open at any width desired.



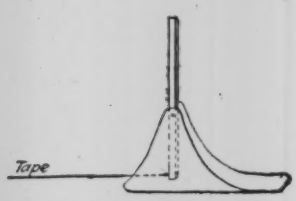
TOOL CONTROLS TRUCK DOOR OPENING

As used in Virginia, the tool is handled by one of the stone spreaders and it is stated that the men, usually negro convicts, become very skillful in its use. The sketch and description have been furnished by Clement Tingley, Blacksburg, Va., Virginia State Highway Commission.

Two Hints for City Surveying

BY HUGH C. MITCHELL
Mathematician, Division of Geodesy, U. S. Coast and Geodetic Survey, Washington, D. C.

TWO interesting details have been recently developed by the U. S. Coast and Geodetic Survey in running a line of precise traverse which extended nearly the length of one of the Middle States. Both of these developments may prove of value to the engineer who is running a traverse of any class through city streets. One is the satisfactory use on city streets of a piece of ordinary adhesive plaster as a tape-end station. The plaster is simply attached to the smooth pavement, and the tape end marked thereon with a hard pencil. Such a mark will remain in place several days.



TAPE STRETCHER

The other development is a simple tape stretcher, which permits holding the tape close to the ground. It was designed by J. S. Bilby of this Bureau. It can easily be constructed of sheet metal of ordinary weight, cut and bent into shape and fitted with a handle held in place by a bolt. The accompanying drawing gives a better idea of how to construct it than can be put into words, and its method of use is most obvious.

Batch-Box Trains Employed for Winter Stockpiling

YEAR-AROUND industrial railway operation was successful in building, in 1920-21, an 11-mile concrete road in Palo Alto County, Iowa. About 28,000 cu.yd. of pit-run gravel were required for aggregate One-half of the gravel was hauled from pit to mixer for the first 5½ miles of road, and the other half was hauled from pit to stockpile and then from stockpile to mixer for the second 5½ miles.

At the pit, as is illustrated, a cableway dragline placed the gravel in a pile from which a mechanical loader put

LOADER CHARGED BOXES AT PIT

it into batch boxes on industrial cars. About 2 miles of road were built in 1920, the hauling of aggregate for this section being direct from pit to mixer. Then paving was shut down because of cold weather. During the winter the material for the stockpile for the second half of the road was excavated at the pit, loaded into batch boxes, and hauled to the stockpile. Here the material from the boxes was unloaded by a traveling crane into a pile 250 ft. long, 115 ft. wide and 13 ft. high, containing about 14,000 cu.yd. When warm weather came in 1921, pavement laying was resumed, the hauling of aggregates being again direct from pit to paving mixer.

In this way 3½ miles were paved, bringing the work up to the stockpile. Pit operations were then discontinued and the loader and industrial railway outfit were transferred to the stockpile. The loader started at one corner of the pile and worked along the 115-ft. face cutting a swath 22 ft. wide and loading directly into the batch boxes. Ten-car trains were run with two 22-cu.ft. batches per car. When a cut along the face was completed, the industrial truck and loader were moved up and the loader worked back, taking out another 22 ft.

The contractors were the Brereton & Bauck Co., Emmettsburg, Iowa.

FROM JOB AND OFFICE

Hints That Cut Costs and Time

Semi-Removable Centers for Concrete Bridge Arches

BY HOWARD G. PETERSON
Assistant Engineer, Miami Conservancy District, Dayton, Ohio

THE necessity of keeping falsework under the completed arches until all seven were poured, led to the design of semi-removable centers for the Black Street Bridge at Hamilton, Ohio. The plan was to remove the lagging, stringers, caps and the batter posts, shortly after the concrete had set. The undisturbed skeleton structure which remained then took the vertical load from the green arches and also supported the spandrel walls and cantilever sidewalks. The parts which were removed were reused on the new arches.

The arches are each 38 ft. wide and 93 ft. c. to. c. of piers. Five bents supported each arch. They were placed about 16 ft. apart to permit flood waters to pass.

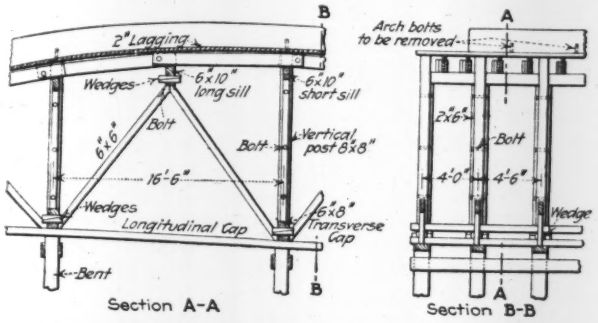
A deck of longitudinal timber was placed on top of the bents on a line with the tops of the piers. This deck helped brace the bents and also took the side thrust from the batter posts. Caps were placed on top of the deck, one over each bent, which supported the wedges for the vertical posts and also acted as heels for the batter posts. The vertical posts were placed 4.5 ft. on centers and extended to within about 2 in. of the intrados of the arch. Pieces of lagging were placed over them and provided with bolts which would fasten them to the arch when it was poured. Their purpose was to brace the posts after the stringers and much of the bracing had been removed. A strip of 2 x 6-in. lumber was bolted to the side of each post; these strips carried short caps between the posts which in turn carried the stringers. When the stringers were to be removed, the strips were unfastened and sprung out of plumb, thus lowering the short caps. The batter posts were placed entirely independently of the vertical posts and were provided with wedges at the top. The stringers and

FROM JOB AND OFFICE

For Contractor and Average Engineer

lagging were placed in the ordinary way. Only three sets of the removable parts were used.

The bridge was built by the Miami Conservancy District for the city of Hamilton, since the construction of



CENTERS FOR BLACK ST. BRIDGE, HAMILTON, OHIO

the bridge was so interlinked with the channel improvement that the district's forces which were on the site could easily handle the work for the city. The falsework was designed by the writer and R. M. Reigel who was then designing engineer. The construction work was under the direction of C. H. Eiffert, division engineer and William Roush, superintendent.

Sand and Air Dryers for Cement Gun Work

In the construction of the gunite conduit at Tacoma, Wash., described on page 906, June 1, 1922, W. A. Kunigk, Superintendent of Waterworks, found it necessary to dry the sand and the air used in the cement gun. He describes the devices for that purpose as follows:

The sand-dryer was built by supporting a $\frac{3}{16}$ in. x 6 ft. x 10 ft. plate over a firebox and circulating duct built into the ground and lined with 1:3:6 concrete, connecting with a 10 in. sheet-iron stack. For fuel, slabwood in 4 ft. lengths was used. The screen consisted of a 2 ft. diameter by 6 ft. long steel wire drum having four meshes to the inch. This drum was fastened to a central shaft by three spider frames with the shaft supported in boxing resting on a wooden frame in a slightly inclined position. The screen was operated by a small gas engine connected to the screen with a belt and beveled gear.

On some previous work on which a cement gun was used by the water department during extremely wet weather, considerable trouble developed on account of the moist air condensing in the air line leading to the gun. This condensed water would get in the bottom of the gun and mix with the cement and sand and choke up the feed wheel about every half hour, thereby stopping, of course, all operations. The writer came to the conclusion that if dry air could be supplied there should be no trouble in operating the gun regardless of weather conditions. An air-dryer was therefore made, consisting of a welded tank of No. 12 gage steel 20 in. in diameter and 4 ft. 6 in. long provided at each end with a $2\frac{1}{2}$ in. pipe connection and at the bottom with a $\frac{1}{4}$ in. pet-cock and a hand hole on top. Near the outlet end a $\frac{1}{4}$ in. mesh screen of galvanized iron had been inserted before welding this end. This tank was filled through the hand hole with coke and then out into the air feed line near the cement gun with the pet-cock left slightly open for the purpose of blowing off the accumulating water. No trouble has been experienced by the writer in using the cement gun in wet weather wherever this simple device was used. The reduction in air pressure from use of the dryer was negligible.

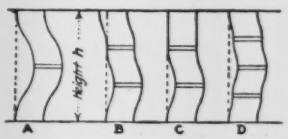
The Length of Columns

BY DAVID C. COYLE
Gunvald Aus Co., Consulting Engineers, New York City

WHEN two columns more than one story high stand separated from other framework in a building, the question of their effective length is sometimes solved in a more casual way than the situation warrants. Every engineer realizes that they may possibly fail together instead of bracing each other, and the fact is generally recognized that if they are only joined by light members, such as a 6-in. I-beam or a pair of angles, these members will have practically no effect in shortening the column length. It is not always so obvious, however, that a stiff brace, say a 10-in. I-beam with top and bottom connections, may be of no value; and that several such braces may produce less stiffening effect than is expected.

Sketch A in the drawing herewith shows the action of a pair of columns with a brace between them at mid-height. In the absence of any force capable of holding the mid-point against lateral displacement, it is evident that the columns can fail together without deforming the brace in any way, and consequently without bringing it into action. Of course, if the two columns, on account of initial bending, tend to buckle in opposite directions, the brace will be of use; but such a condition is entirely a matter of chance. Where there is a curtain wall, or a floor connected to other framing, built in place before these columns get their load, they may stand as solidly as if they were properly braced; but the fact remains that this construction leaves more to the element of luck than good practice usually requires.

Sketches B and C show the effect of two stiff braces. If the tops of the columns are secure against lateral motion, the length of each column may be taken as practically equal to thirds of the total, or the distance between any two alternate braces. Incidentally, it may be noted that a single brace, if not placed at mid-height, would necessarily have some effect in stiffening the columns, since they could not fail together (as at A) without bending the ends of the brace; also, the actual depth of any brace is of course subtracted from the effective height of the columns. But it is not justifiable to put one brace at the third-point and take $\frac{2}{3}h$ as the effective height, for sketch C shows that the second brace has a necessary part to play in keeping the top section straight.



HOW HORIZONTALLY-BRACED COLUMNS MAY BUCKLE

A possible mode of failure with three braces is shown at D, which indicates that the column length may be greater than the distance between two alternate braces. The natural conclusion seems to be that in a situation of this kind one must either provide some external means of lateral stiffening, or use diagonal bracing, or figure the column length as being at least two-thirds the total height. For even though, as in case D, very little actual column bending may get past a given brace, the lateral displacement may be such as to throw an extra load on one column, tending to increase with increasing deflection, and thus acting to

produce an effect similar to that due to a greater length.

The same reasoning applies to another case, that of two angles acting as a compression member in a truss. It is often necessary to insert washers and tack-rivets to prevent such a strut being weaker in detail than as a whole. A single washer halfway between the gussets will have no effect whatever. It is even possible for a case such as that of sketch D to arise, in which, without shearing any of the tack rivets, a larger buckle can occur in the middle than would be due to a length equal to the distance between alternate tack-rivets. This fact may help to account for an occasional failure otherwise inexplicable. Ordinarily, of course, the safety factor covers a multitude of theoretical sins. The theory does, however, indicate the desirability of inserting enough tack-rivets so that the detail length between alternate rivets shall be markedly less in proportion to radius of gyration than that of the member as a whole.

Where compression members are battened the situation may be even worse, because of the longer lever arms and greater possibility of lost motion. The theory indicates the comparative value of latticing or else of unusually close battening, where members are to take compression. Tests made by the American Railway Engineering Association in 1917 bear out this theory. Their report, dated February, 1918, states, "where distance center to center of outer rivets on adjacent battens is fixed so that the $\frac{l}{r}$ distance for the individual channel is about the same as for the column as a whole, the column is weaker than when this distance is reduced. In all cases columns with battens failed at an ultimate strength of 6,000 to 9,000 lb. per sq.in. less than columns with lacing." Their conclusion is that "columns with batten plates do not develop the strength of the section and should not be used."

No attempt is made here to treat these factors analytically, as the results of a careful analysis might easily be masked completely by some inaccuracy of shop work or, in the case of light members, by some hardly noticeable defect due to injury in handling. It seems reasonable to say, however, that the long-suffering safety factor ought not to be obliged to carry any other load than that due to such accidental weaknesses. The nominal character of the floor loadings and column formulas required by law, as well as the cost factors involved, will render it absurd to go too deeply into mathematics in a discussion of this kind, but it does not follow that no consideration at all is necessary in such cases as those mentioned above. The means commonly used for reducing the length of compression members require very careful scrutiny, or it may easily happen that such members will be in reality twice or three times as long as they actually appear to be.

FROM JOB AND OFFICE

Hints That Cut and Time

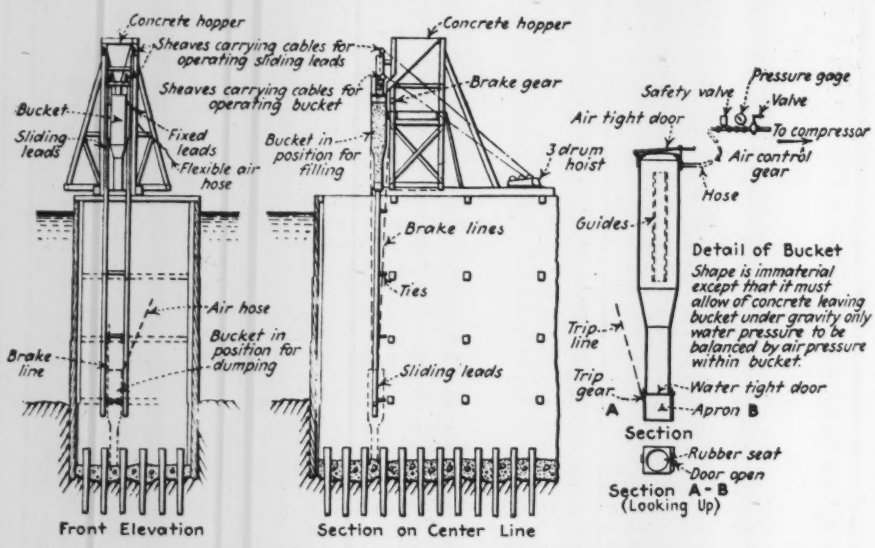
Underwater Concrete Laid by Unique System

IN THE construction of the Jackson Street bridge, Victoria, B. C.—a combined railway and highway bridge across the inner harbor built by the City of Victoria with the help of the Canadian Pacific Ry. and the provincial government—the method used for underwater concreting was entirely new. The system was devised by F. M. Preston, city engineer of Victoria. Mr. Preston has applied for U. S. patents for his device, the Preston "Underwater Concrete Bucket."

As described in *Concrete and Constructional Engineering*, London, the principle involved in this new manner of underwater concreting is the depositing of concrete from a watertight bucket by displacement of air instead of water.

As shown in the accompanying sketch, concreting by this method is done in this particular instance from the top of the pier caisson. The concreting equipment is mounted on a decking which supports a more or less simple frame containing the concrete hopper. Motive power is supplied by a three-drum hoist. The sliding leads extend down into the water the required distance and in these leads the bucket operates.

The bucket used in the construction of the Victoria bridge held 1 yd. It received its charge of concrete in its upper position, the doors were then closed and the bucket lowered to its correct position under the water. An internal air pressure sufficient to balance the water pressure on the outside was maintained, the lower door released from the surface and the contents then discharged and the operation repeated. The work was carried out continuously until completed.



PRESTON UNDERWATER CONCRETE BUCKET

The actual entire labor cost of mixing and placing was approximately $1.50 per cu.yd. Water was afterward pumped out from the caissons with no difficulty and the concrete found to be of excellent quality after removing from 3 to 18 in. of laitance.

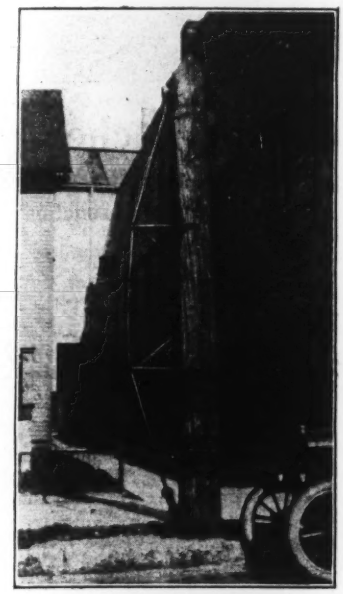
FROM JOB AND OFFICE

For Contractor and Average Engineer

A Wrongly Braced Guy-Pole and Other "Practical" Errors

By Charles S. Stewart
Milwaukee, Wis.

NO DOUBT the man who designed the guy-post reinforcing shown by the accompanying view considered that what would strengthen a simple beam would also stiffen a cantilever. While it is true that the truss will reduce the deflection of the guy post any slight gain in that direction is nullified by the deep notching of the base to allow for setting in four vertical bars and the heavy band for anchoring the lower end of the truss rod. This is one of a number of similar installations in the system of a large public-service corporation.



INEFFECTIVE TRUSSING

Perhaps other readers of *Engineering News-Record* have seen examples of construction of as low efficiency as this, but as a rule these cases are not exposed to public view. I once saw a foreman who insisted on placing tension reinforcement in the top of a concrete slab to avoid bending the bars on account of transverse beams. He argued that the bars were as stiff in the top of the concrete as in the bottom; also that the slab was only a cover for a coal bunker and would never be loaded. When I saw it next the slab was carrying a load of fire brick piled three feet high.

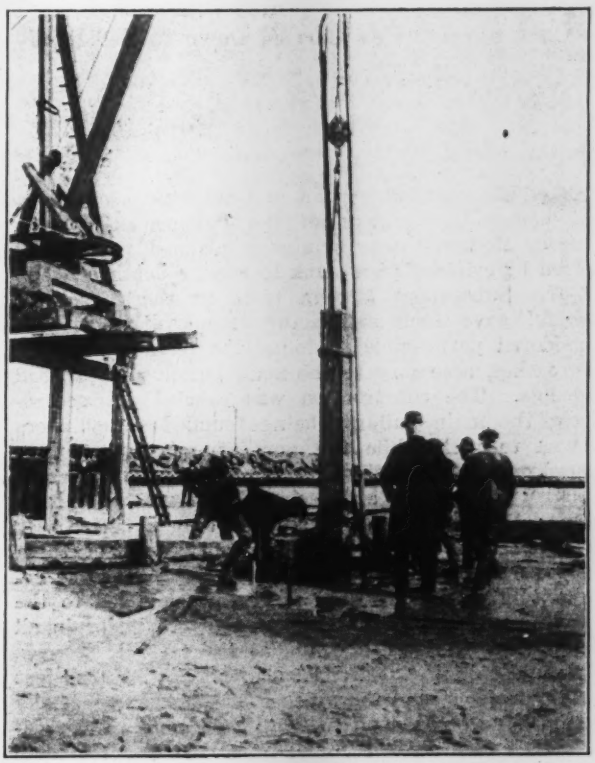
The young engineer on construction work has frequent opportunity to see the difference between theory as worked out in the engineering office and practice as carried out by the so-called "practical" man in the field. If he offers a suggestion or remarks about these inconsistencies, he is likely to be told that these matters are not in books but must be learned from experience.

After a building is erected alterations are often made, and sometimes large additional loads are applied without regard to the original design. I have seen cases where kneebraces and even main members of roof trusses have been removed. However, due perhaps partly to calculated loads being larger than actual loads, the structure did not collapse. But sometimes a structure fails under stresses due to construction loads, and loss of life ensues. More often, probably, the error is in the other direction and results only in a waste of money, as in the case of the guy post.

Timber Serves as Line and Grade in Jetting Piles Into Place

JETTING into place about 4,000 reinforced-concrete piles that form the foundation for the reinforced-concrete boardwalk being constructed along the Coney Island beach, New York, necessitated the use of the most expeditious method of doing the work. The extreme depth of the sand at this location makes jetting a relatively simple matter. In jetting the piles approximate line and grade was furnished by a heavy timber resting upon two short wooden piles driven into place ahead of each concrete pile bent. This timber, which was ordinarily 12 x 12 in. was placed on the short piles so that its outer face was plumb and set back from the center line of the concrete pile bent half the width of the piles.

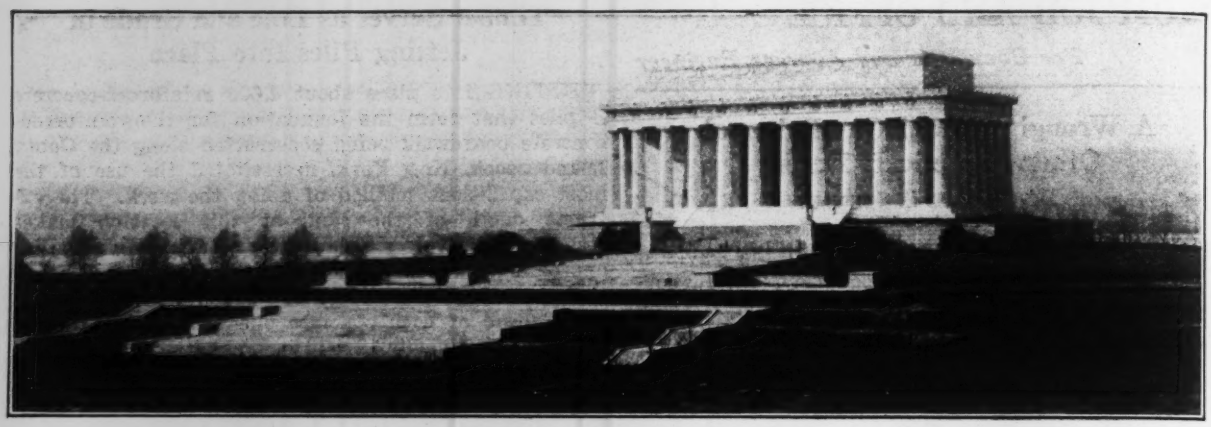
Blocks were spiked to the side of the timber to serve as guides to the pile and to insure proper alignment.



JETTING INTO PLACE REINFORCED-CONCRETE PILE

Heavy iron dogs were used to clamp the timber to the piles and additional braces were usually used. By means of a level the relation of the upper surface of the timber to the grade of the pile was established. The proper distance was marked off on the concrete pile so that when the mark coincided with the top surface of the timber the pile was at the proper grade.

In jetting, the piles were set flush against the face of the timber, and the pile lowered between the blocks that serve as guides. By this method there was no difficulty in setting piles within an inch or so of the proper grade and within close to a half-inch of the proper line.



Underpinning Lincoln Memorial, Terrace and Approaches

Spread Footings Which Settled with Subsidence of Surrounding Fill Replaced by Concrete Piers Built in Open Sheeted Pits Carried Down to Bed Rock—Steel Supporting Girder System Under Approaches

By D. L. Weart
Major, Corps of Engineers, U. S. A.,
Assistant to Executive Officer, Lincoln Memorial Commission,
Washington

LOCATED on filled ground in what was originally a shallow bay or arm of the Potomac River, the Lincoln Memorial was originally planned to be supported by cylinder piers sunk to rock, a depth of 50 to 65 ft. Subsequent loading tests on the subsoil of the fill gave such satisfactory results that it was considered permissible to found the terrace wall and approaches, accessory to the main building, on spread footings. The construction was carried out accordingly, the main building being founded on cylinders driven to rock while the auxiliary structures were placed on spread footings. Even during the course of construction of the approach and terrace wall, however, settlement of larger amount than expected was observed, and ultimately the masonry work of these portions became cracked and displaced. As the settlement continued, a restudy of the problem led to the conclusion that it would be necessary to underpin all the spread footings by foundations carried to rock. This underpinning, described in the following, has just been completed, and the finished structure, as formally inaugurated on Decoration Day, rests on rock foundation throughout. The foundation work for the main structure was described in *Engineering News*, May 7, 1914, p. 1019 and March 23, 1916, p. 558.

Conditions at Site—Filling of the bay or marsh at the present site of the Lincoln Memorial began in 1882, and up to 1900 about 4 ft. of hydraulic fill had been placed. The remainder of the fill to the present grade, about 3 ft., was placed in 1908. A typical boring on the site shows:

El. +16 to +12, sandy soil
+12 to + 4, sand and marsh sand
+ 4 to —10, sand and gravel
—10 to —36, marsh sand
—36 to —38, rotten rock
—37 down, blue gneiss

Several tests were made in 1913 to determine the bearing power of the soil. In these tests loads of 3,500 to 4,500 lb. per square foot were applied. The settlement amounted to 8 in. in four months, with no settlement during the following two months. Later load tests, made in 1917, confirmed these results.

Foundations of Main Building—The memorial building is a structure of pure Grecian architecture, similar in design to the Parthenon. It is 201 ft. 10 in. long by 132 ft. wide at the outside of the bottom step of the stylobate course, or 181 ft. by 111 ft. 2 in. along a line running through the center of the columns of the colonnade, and is 57 ft. high from the floor of the hall to the bronze beams of the ceiling. It is largely built

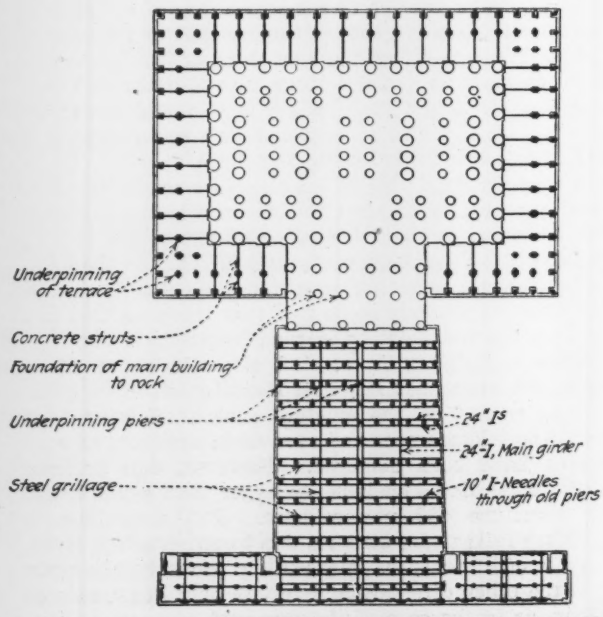


FIG. 3. DIRECT UNDERPINNING OF TERRACE COLUMNS AND STEEL GRILLAGE SUPPORT OF APPROACHES

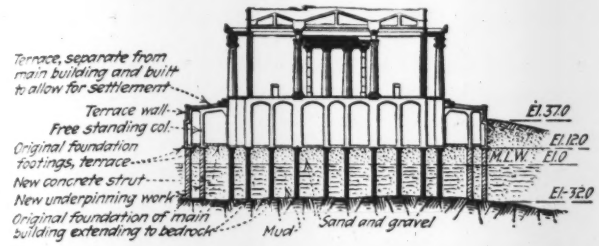


FIG. 3. TERRACE UNDERPINNING IN CROSS-SECTION

of marble and granite, and thus is an unusually heavy structure.

The foundations consist of two separate portions: The portion below the original level of the ground, known as the subfoundation, and above this level an upper foundation consisting of concrete columns about 45 ft. high connected at the top by arches poured integrally with them.

The subfoundation consists of 122 concrete piers formed in steel cylinders driven to rock, ranging from 49 to 65 ft. long and from 3 ft. 6 in. to 4 ft. 2 in. in diameter. The steel shells were sunk to refusal by heavy weighting, assisted by water jetting; the earth was then removed from the interior of each cylinder, the bed rock was excavated 2 ft., and the entire shaft was filled with concrete reinforced with twelve 1-in. square twisted bars set vertically around the periphery. At the ground level the tops of the cylinders were splayed out to rectangular shape and connected by a mat of reinforced concrete 12 in. thick.

Terrace and Approach Foundations—The original plans for the memorial called for the foundations under the terrace wall to be carried down to rock in a manner similar to the foundations of the main building. After the bearing power of the soil had been determined, the scheme of putting the terrace wall on spread footings was investigated.

It was found that the pressure under the proposed footings would be practically the same as the pressure on the original soil due to the weight of earth fill, about 2,300 lb. per square foot. As the ground appeared to be stable under this load, and as the loading tests had indicated a bearing power of more than 3,000 lb. per square foot, it was decided to adopt the spread foundation, and to design the wall to allow for a settlement of about 8 in., which was the settlement developed in the load tests.

Accordingly, the beams supporting the deck slab were designed to act as struts between the top of the retaining wall and the building, so as to prevent the wall being forced inward by the outside earth pressure. The ends of these struts were placed in slots in the wall of the main building (without rigid connection) so that they could move and adjust themselves to settlement of the terrace wall, but would yet hold the wall outward.

In preparing for the construction of the approaches, which were built under a separate contract, the conclusions already reached for the terrace wall foundation were applied, and spread footings were decided upon.

Serious Settlement During Construction—Work on the terrace wall began in the latter part of 1917. Construction was started at the south buttress of the main steps, and extended progressively around the memorial to the north buttress.

When work stopped in December, 1917, the wall and slab deck had been poured entirely on the east side and the wall about one-third completed on the south side. During November and December, 1917, the backfill was made on this portion of the wall. Levels taken at the southeast corner in March, 1918, showed a settlement of 0.11 ft. At this time the wall had nearly all of the load it would have to sustain. The deck slab at the southwest corner was poured in June, 1918, and up to September the settlement at that point was 0.26 ft. When the backfill was made at this corner the settlement became much more rapid, so that by November it had reached a total of 0.59 ft. During this settlement the wall maintained its alignment, and the horizontal joints of the granite were not affected.

Similar conditions to the above held true during the remainder of the construction. The average settlement to July, 1921, when work was started on underpinning, was a little over 1 ft. This settlement of the terrace walls and approaches was not a settlement of the structures themselves with respect to the surrounding ground on which they were placed, but was part of a general subsidence of West Potomac Park, due to the slow compacting of the hydraulic fill placed there between 1882 and 1908.

In 1920 a thorough investigation was made of the effect of the settlement on the deck, walls and approaches. The structures were taking up the settlement as they were designed to do, but it would not be safe to permit the settlement to go on indefinitely. As there was no indication that the settlement would stop in the near future, it was decided to underpin the foundations.

The scheme for underpinning contemplated sinking steel cylinders between the columns supporting the wall and the deck to bed rock, filling them with concrete, and carrying the load by means of transverse steel beams resting on the columns and carried in under the foundation footings. Before work was commenced, however, the scheme was changed to provide for concrete columns being placed directly under the piers supporting the wall and terrace, thus eliminating the beams. The foundations of the approaches were to be supported on a system of steel girders resting on concrete piers carried to bed rock, with steel needle beams

FIG. 4. NEEDLE AND GIRDER SUPPORT OF APPROACHES

through the columns; this plan was carried out unchanged.

Method of Underpinning—The free-standing columns were shored up with 12 x 12-in. timbers before excavation was begun. Access pits 6 ft. square and 12 to 14 ft. deep were then sunk between these columns and the terrace wall, by driving sheet piling and excavating within. Their bottoms were concreted, and a sump 18 in. deep, which extended below groundwater, was constructed in one corner of each. Suction lines of the pump system were connected to each sump.

Pier excavation was started from near the bottoms of the sides of the access pits by cutting the timber sheeting adjacent to the terrace wall and to the columns and drifting horizontally under the foundation footings to the exact positions of the new piers, which were carried down to rock in extension of the original piers. The shafts were 2 ft. 6 in. x 4 ft. 10 in. in horizontal dimensions, and were lined with 2 x 12 horizontal sheeting in sets placed as the excavation went down, cross-braced in the narrow direction every 8 ft. in depth.

Excavation was done by pick and shovel, and the water was kept down by air pumps. The shafts were carried down through sandy loam for 8 or 10 ft., then through stiff mud to about 3 ft. above bed rock. Here decayed rock, which was very soft and after removal appeared very much like coarse sand, was encountered. Sometimes large boulders were found just above the soft rock. The surface of the bed rock, found broken off at various angles without any relation to the strata or fault planes, was drilled off level or, if one portion of the surface was higher than the other, was cut in steps so that the bearing was level. When a suitable bottom had been obtained with all dirt and water removed it was passed upon by an inspector. The shafts varied in depth from 40 to 60 ft.

Immediately after a shaft was inspected, concreting started. The pouring in each shaft was continuous except for the time required for removing the braces and spading the concrete; it took 4 to 8 hr. (14 to 20 cu.yd.). The concrete was poured to within 6 in. of the bottom of the old footing, any laitance on top was removed and the pier was allowed to set for seven days. The 6-in. space was then filled with a very dry mixture of concrete, of which a small amount was rammed in at a time, to make it wedge as compact as possible. The pier was then allowed to take the load.

After the piers took the load the walls continued to settle for a time. This was due to the compacting of the mass in the long newly constructed columns. If the piers could have set for 28 days instead of 7 before the load was applied it is not believed that this settlement would have occurred.

As each set of adjacent piers under the columns and the terrace wall was completed, the access pit was filled with earth. Concrete struts 12 x 24 in., reinforced with four ¾-in. rods, were constructed, extending from the foundation wall of the main building to the free-standing columns and from these columns to the terrace wall. These struts are supported on the original footings of the columns, and at the building and terrace wall the rods were grouted into the old concrete.

Operations were carried on simultaneously under every second set of free-standing columns and terrace-wall footing. After these had been completed, work was commenced under the intervening sets.

Underpinning the Approaches—A different method of underpinning was employed for the approaches. Fewer piers were sunk, and the columns were supported on a system of steel girders with steel needle beams as shown in Figs. 2 and 4.

A longitudinal system of 24-in. I-beams (*A* in Fig. 4) supported on 2 x 4-ft. concrete piers extending down to rock, similar to those used under the terrace wall, was constructed. Some of the concrete piers are in the open, so that the steel rests directly on them, but the majority are under the old existing column footings, and here the beams are supported by concrete pedestals built up to the proper height on these old footings. On the longitudinal beams was placed a transverse beam system of pairs of 24-in. I-beams (*B* in Fig. 4), one beam on either side of a line of columns. The transverse beams in turn carried needle beams (*C* in Fig. 4) passing through the columns. These are short lengths of 10-in. I-beam, and take the load of the concrete piers.

The cavities between the needle beams and the columns were filled with dry concrete rammed so as to fill all voids. Special care was taken to insure a good bearing between the columns and the needle beams. All of the steelwork was finally encased in concrete, to protect it.

Plant Used in Underpinning—The plant used for the work comprised pumping, compressing, concrete mixing, hoisting, transportation, and electrical equipment, besides minor auxiliaries. Its chief items were:

For pumping, two 10-hp. electric pumps with a combined capacity of 30,000 gal. per hour, connected with a pipe system which had intakes at various points throughout the work and discharged through a 3-in. line to the river; and five small air-driven pumps for keeping the pier shafts clear of water. For air supply, a 10-hp. compressor which supplied 600 cu.ft. per minute to drill pile drivers, augers, and the small pumps. For concrete mixing, a ½-yd. motor-driven mixer fed by gravity. For handling the spoil buckets in the pier shafts, six 5-hp. electric hoists. For transport, an industrial railway connecting all parts of the work; dump cars of ½-yd. capacity carried the concrete, while flat cars served for other material, the cars being pulled by a cable operated by a 15-hp. electric hoist. For electrical supply, a 220-volt generating plant for power service and a 110-volt plant for lighting, carrying 300 lights.

The total value of the construction plant was about $25,000, including an installation cost of $5,000.

Summary—A total of 176 piers, 68 struts, and 210 tons of steel, was required to complete this work. The cost was $215,000. The work was performed by the Terry & Tench Co., Inc., of New York, for the Lincoln Memorial Commission, under the direction of Lt.-Col. C. O. Sherrill, executive officer of the commission.

Japanese Plan 1922-23 Railway Construction

Construction of 331 miles of new railway complete and ready for traffic is included by the Japanese government in its program for the government railways during the financial year 1922-23. The work is to be distributed over 35 lines and contemplates the completion of 29 of them.—*Commerce Reports.*

Belle Isle Bridge Steelwork Placed by Floating

Umbrellas for Concrete Cantilever Spans Assembled on Pile Bents Near Shore and Moved to Place on Scows

CONSTRUCTION work on the steel and concrete cantilever-arch bridge of the city of Detroit, connecting the mainland with the city park on Belle Isle, has been in progress since last fall, and a number of the concrete piers have been completed by the contractors, Greiling Bros. The Wisconsin Bridge & Iron Co., contractor for the steel ribs, has begun erection, and several of the umbrellas, consisting of the adjoining halves of two spans, have already been set in place. In this work the interesting expedient of assembling the umbrellas near shore, at some distance from the site, and floating them to the bridge by scows has been adopted, by which means all questions of falsework at the bridge site are eliminated.

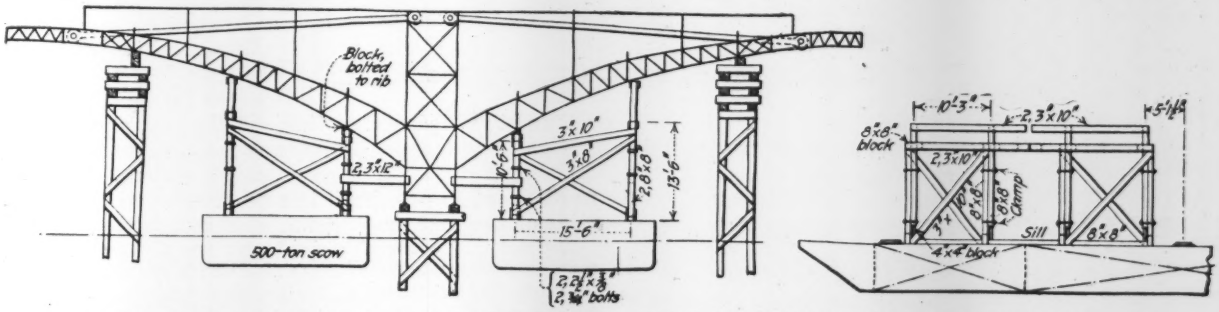
As described in *Engineering News-Record* of March 17, 1921, p. 452, the bridge is about 2,200 ft. long over all and consists of arch-shaped spans of lengths 74 ft. to 135 ft. center to center of piers, with rise ranging up to about 25 ft. for the longest spans. Each span consists of two cantilever arms and a short suspended span in the middle. The steel framework, of the general arrangement shown in the sketch herewith, is proportioned to carry its own weight and that of the forms and concrete of the ribs, while the load of the deck structure, pavement, and traffic will be resisted by joint action of the concrete and the steel.

For assembly of the steelwork, the contractor secured the use of a small portion of the upper end of Belle Isle. The steel is received by rail at a gravel dock on the Detroit side of the river, where a self-propelling derrick running along the dock is available for transferring it to barges. A derrick set up at the assembly yard here unloads the barges and stores the steel.

A unit or umbrella comprising the steel tower over a pier and the two abutting half ribs is assembled on pile bents as indicated by the heavy lines in the sketch. The tower is first set in place on the central pile trestle, and is bolted up complete with its bracing. Next, the preassembled half ribs are swung to place individually, connected to the tower, and supported near their outer ends on the outer falsework tower. The latter was built low enough to take the smallest span, and blocking is used to make the proper height for the longer spans. The eyebar backstays are then connected by their pins on the tower end, and when all in place are connected pair by pair at the outer pins. Finally the deck framing and bracing are placed and bolted up and the unit is ready for floating to the site. All the work at this stage is bolted, no riveting being allowed at the assembly yard under the order of the engineers, Esselstyn-Murphy, of Detroit.

For floating to the bridge site, two 102-ft. scows are placed transversely under the haunches of the half arch ribs. Two sets of adjustable bents on each scow form a support for blocks bolted to the ribs. The scows are flooded sufficiently to give a lift of about 3 ft. When placed under the ribs they are fitted to bearing against the steelwork by raising the adjustable bents and clamping them in position, and then the scows are pumped out. As soon as the steelwork comes to bearing, small posts are put under the adjustable sections of the bents to take the load, and then the pumping is continued until the scows lift the steel clear of the falsework.

After a two-scow unit is floated to the bridge site, it is swung around above the pier on which it is to be set and permitted to float down slowly with the current under control of the tug and tag lines until the steel tower is directly over the anchor bolts. The unit is then settled slowly into place by flooding the scows, one end being allowed to go down somewhat ahead of the other to facilitate the entering of the anchor bolts. As soon as the steel is landed the scows are sunk clear, pulled out from under, and pumped out for return to the assembly yard for the next unit.



SUPPORTS FOR ASSEMBLY OF BELLE ISLE BRIDGE STEELWORK AND ARRANGEMENT FOR FLOATING

The scows are flooded by pumping water into the compartments with gas pumps, of which one is provided on each scow. Three-inch natural siphons assist in the early stages of the work. Unwatering is done by means of the gas pumps.

The units of steelwork range from about 100 to 230 tons in weight. It is found an easy matter to assemble, float, and land two units in ten days. For this rate of working four men are required on the assembly work and a small gang is taken from the work at the bridge to assist in landing the steelwork on the piers.

Italy to Spend Large Sum on Railroads

It has been recently announced that the Italian Government in the next four years will spend 1,750,000,000 lire for state railway renewals and replacements that were deferred by the war and by the difficulties encountered since. Of the sum to be expended, 450,000,000 to 500,000,000 lire have been allotted for shops, buildings, and repairs to the line. At the instigation of the Treasury Ministry, the government, in electrifying the railways or improving them extensively, is inclined to take much of the material and equipment needed from Germany by way of reparations.—*Commerce Reports.*

Patrol Maintenance Practice in North Carolina

Organized by Districts—Patrolmen and Floating Gangs Combined—All Operations Motorized—Central Office Inspection and Planning Gives Uniform Inter-District Practice

MAINTENANCE was the first work organized in undertaking the fifty-million-dollar bond issue highway improvement program in North Carolina. Within four months after the creation by law of the state highway commission a state system of 5,500 miles of roads had been taken over and put under maintenance. The object of this quick action was twofold. It gave immediate results in improved conditions of travel and it permitted time to be taken, without challenging criticism, for the greater improvement of new construction to be adequately planned. Incidentally it went far toward converting the people and the newspapers, who had doubted the wisdom of assuming so great an indebtedness for highway improvement.

North Carolina has within a period of 15 *months by well planned maintenance put over* 5,000 *miles of inadequately maintained main highway into excellent condition to serve traffic. The accompanying notes on the organization and the methods employed are based on an inspection trip by automobile of about* 600 *miles supplemented by records of practice and costs furnished by Frank Page, state highway commissioner, and Charles M. Upham, state highway engineer.*

Previous to state organization, all maintenance of the main roads forming the 5,500-mile system had been carried on by the counties each operating independently. Commonly the results were inadequate and always there was no inter-county uniformity of standards. While this gave state direction an opportunity to make its greater effectiveness quickly visible, it put it to a heavy burden of expense and effort in recovering a large mileage from a condition of bad repair. In many instances virtual reconstruction was required to bring the old road to a condition for maintenance as that process is commonly comprehended. This fact has to be kept in mind in appraising some of the records of extra crew operations and some of the mileage costs which will be presented.

For all state highway improvement—both construction and maintenance—North Carolina is divided into the nine districts enumerated on the outline map. In each district there is a district engineer in charge of all state roads. Under him there are a construction engineer and a maintenance engineer, the latter being in immediate charge of maintenance. This form of organization is that of Maryland and differs from that common in most states and universal in the middle west, which provides for a state construction engineer and a state maintenance engineer responsible only to the highway commission and its chief engineer and having authority independently of each other. The theory of the North Carolina plan is that the district engineer being responsible both for construction and for maintenance after construction, will direct construction with more attention to the cost and efficiency of its future maintenance.

While the district engineers are responsible for the maintenance work in their districts and in a considerable degree independently responsible, there is such control from the state highway commission and engineer as is needful to maintain standards, regulate costs and insure inter-district uniformity in practice. For example, patrol maintenance is universal and district organization and equipment are substantially uniform. Reports from the districts keep headquarters informed of operations and costs and results are checked by frequent inspection from headquarters. Ultimately it is planned to have headquarters maintenance engineers, as there are new headquarters construction engineers, experts in their calling, who will travel continually from district to district, checking results and giving advice on methods and practice.

Topographically North Carolina consists of the eastern coastal plain, the rolling hilly Piedmont section and the rugged mountain section in the west. Maintenance conditions are quite different in these three geographical regions. Practice as disclosed in five districts representing all three sections of the state are epitomized as follows:

District 2 (Coastal Plain)—There are 512 miles under maintenance exclusive of 108 miles under construction and 20 miles not yet accepted for maintenance. The types of road are as follows:

Asphalt	69.4 mi.	Surface treatment	21.1 mi.
Brick	29.0 mi.	Shell	2.5 mi.
Concrete	6.0 mi.	Top soil	102.2 mi.
Dirt grades	33.4 mi.	Unimproved	144.8 mi.
Sand-clay	235.6 mi.	Total	640.6 mi.

The maintenance force consists of two supervisors, two roadway floating gangs, one bridge floating gang, one shop crew and 27 patrolmen with 60 helpers. Each roadway floating gang consists of 1 foreman, 11 laborers and 1 cook and the bridge floating gang has 1 foreman, 5 laborers and 1 cook. At the shop there are 5 mechanics, 1 blacksmith and 1 laborer. The equipment consists of 3 tractors, 36 trucks, 19 road machines, 30 drags and 6 portable shanty houses.

From these figures it follows that the average miles maintained is 19 for each patrolman and 8.5 miles for each patrolman's helper. There are two supervisors covering each 256.2 miles.

District 5 (Piedmont)—There are 701 miles of road in the district all but 120 miles of which is being maintained. The types of road under maintenance are:

Unimproved	93.9 mi.	Surface treated	14.9 mi.
Top-soil	360.1 mi.	Concrete	26.1 mi.
Gravel	57.2 mi.	Asphalt	28.5 mi.

The maintenance force consists of 3 supervisors, 39 patrolmen, 57 laborers, 3 foremen for floating gangs, 1 chief mechanic and 5 mechanics. Their equipment is 8 shanties, 42 trucks, 39 drags, 13 road machines, 4 tractors, 10 mules and 12 trailer dump wagons. Each patrolman keeps up an average of 15 miles of road but the patrol sections vary from 12 to 20 miles long.

District 6 (Piedmont)—Including detours, 696.4 miles are being maintained in 43 patrol sections averaging 16.2 miles each. There is one patrolman and one helper on each

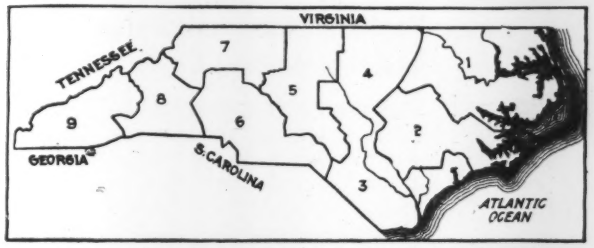


FIG. 1—ROAD MAP OF ENGINEERING DISTRICTS

section. Each patrol has a motor truck, a drag and small tools, and one road machine is allotted to each two patrolmen. The types of roads and the cost of maintenance averaged for nine months are:

Dirt	94 mi.	$121	Surface treated	12 mi.	$52
Top soil	399 mi.	120	Penetration	69 mi.	77
Sand-clay	73 mi.	103	Asphalt	10 mi.	25
Macadam	90 mi.	130	Total	697 mi.	

The cost per mile of field truck repairs has been $14; of sundry and repairs, $5 and materials, $3. An average of about 30 trucks have been used showing an average field expense of about $327 each, not including oil, gas or central shop repairs.

Section 7 (Mountain)—There are 680 miles of road in this district; Table I shows the types and the costs of maintenance. The force consists of 3 supervisors, 49 patrolmen, 150 laborers, 2 mechanics, 1 sign painter, 2 sign erectors, one material clerk, 2 office men and 1 stenographer. For equipment there are 45 trucks, 2 teams, 2 tractors, 2 heavy and 20 light road machines and 42 drags.

Section 9 (Mountain)—About 410 miles are under maintenance by 3 supervisors, 26 patrol crews and three extra crews at an average total cost of $433 per mile and an average labor cost of $214 per mile. The types of road and the cost per mile are:

Unimproved	73.4 mi.	$219	Concrete	14.1 mi.	$846
Dirt	154.8 mi.	423	Top on Mac.	22 mi.	626
Gravel	50.0 mi.	165	Top on Conc.	18.1 mi.	216
Bit. Mac.	13.0 mi.	17	Shale	24.7 mi.	302
W. B. Mac.	13.5 mi.	159	Sand-Clay	16.3 mi.	566

The maintenance equipment consists of 33 trucks, 2 tractors, 22 road machines, 5 motorcycles, 10 trailers and 24 army wagons.

There is little to be gained from the cost figures except the broad fact that in taking over road for high-class state maintenance an extra expenditure for re-

TABLE I—MAINTENANCE COST PER MILE PER YEAR
District 7, 679.8 miles

	Top Soil	Unimproved	Dirt	Dirt	Penetration Macadam	Concrete
Mileage	329.9	172.8	98.7	45.7	22.0	10.7
Labor	$176.83	$86.00	$216.47	$216.47	$121.62	$00.00
Gas and oil	38.05	00.00	38.05	00.00	38.05	38.05
Admistration	12.55	12.55	12.55	12.55	12.55	12.55
Equipment	47.75	47.75	47.75	47.75	47.75	47.75
Bridges	8.28	8.28	8.28	8.28	8.28	
Truck expenses	9.70	0.00	9.70	0.00	9.70	9.70
Repair-Supply	10.29	10.29	10.29	10.29	10.29	10.29
Material purchased	6.56	6.56	6.56	6.56	6.56	6.56
Repair-supply	.....	.....	.....	.....	80.10	.....
Material purchased	.....	.....	.....	.....	111.26	.....
Total	$310.01	$171.43	$349.65	$301.90	$446.16	$133.18
Total less equip.	$262.26	$123.68	$301.90	$254.15	$398.41	$85.43
Total dirt roads deducting $10,000 paid out of Maint. funds for Const. work Blowing Rock Turnpike and equipment	.....	.....	$232.65	$184.90	.....	.....

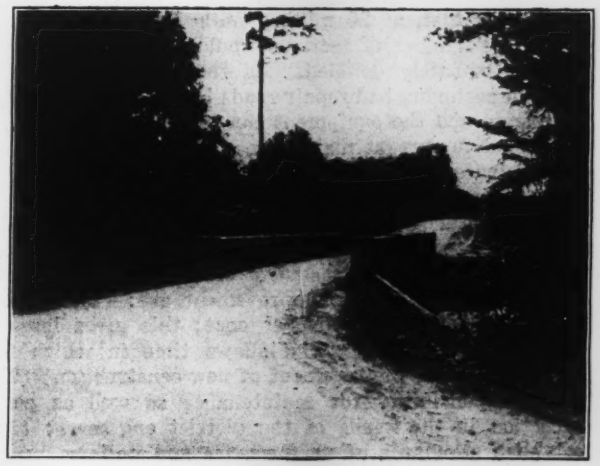


FIG. 2—EXAMPLE OF TOP-SOIL ROAD MAINTENANCE

covering neglected maintenance has to be counted on for the first year or two. In district 9, for example, the excessive cost of maintaining paved road was due to the condition of disrepair in which they had fallen under local maintenance. It may reasonably be expected that the mile-cost of maintenance will begin

Form D 21

NORTH CAROLINA
STATE HIGHWAY COMMISSION
TRUCK REPORT

MONTH APRIL 1922 — DISTRICT NO. 8 — SHEET NO. 1 OF 1 SHEETS — TOTAL NUMBER OF TRUCKS 15

DATE:

TRUCK LICENSE NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
820	R	S	R	R	H	H	D	H	S	H	D	H	R	R	R	S	D	H	H	O	O	O	S	B	B	D	D	H	H	S	

LEGEND

T—Transportation
H—Hauling
D—Dragging
O—Not being used (No work)
R—Down for repairs
B—Not working due to weather
S—Sunday

REMARKS

Note: Lower half of Space is to be filled in with Solid Black when machine is working and to be left blank when machine is not working. Upper half of Space is to be filled in with the proper letter as given under Legend.

SIGNED: _____ DISTRICT ENGINEER

DATE _____

FIG. 3—MOTOR TRUCK EMPLOYMENT RECORD CHART
Similar charts record the service of drags, road-machines and tractors

to show a decrease in another year both because there will be fewer bad repair roads to be restored and because the efficiency of the maintenance organization will be increased.

Standing out sharply in the practice disclosed by the examples given, is the fact of motorized maintenance. With the exception of a rare team patrol, all maintenance equipment is operated by trucks or tractors. There is virtually one truck to every patrol section and two to four 10-ton tractors to every district. This complete tractor operation is reflected in the length of sections maintained which averages upwards of 15 miles and reaches as high as 20 miles. With teams the number of sections would be approximately doubled. As the labor of restoring bad repair roads is completed and the equipment can be restricted to current maintenance it is anticipated that either a lengthening of the sections will be possible or higher standards of maintenance can be maintained.

FIG. 4 — ROUTE AND DIRECTION MARKS ON POLES

Summarized, the lessons of North Carolina's experience in assuming state control of a large mileage of highways for extensive improvement are: (1) Establish intensive maintenance at once; this gives immediate service to traffic and allows time in which to plan the greater improvement of new construction; (2) place responsibility for maintenance as well as construction in the hands of the district engineers; (3) establish standards of performance and uniform practice maintained by orders and inspection from commission headquarters; (4) adopt patrol maintenance assisted by floating gangs for special operations; (5) employ motor trucks and tractors for all patrol operations.

French Trans-Sahara Railway Project

The project for a railway across the Sahara desert to connect the French colonies of northern Africa with those of eastern and equatorial Africa and the Congo region has been revived again by M. Fontaneilles, a French engineer, who bases his plans on the report made early in 1914 by the engineers Legouez and Jullidiere. He proposes to build southwest for 1,980 miles from the Algerian railways to a point on the Niger River where connection would be made with the railway extending from the port of Dakar on the west coast. The railway would then turn eastward toward Lake Tchad with a view to connect with the railways of East Africa and South Africa, eventually completing a north and south route between Algiers and Cape Town, as well as an east and west route between Dakar and Mombasa. In 1914 the cost of the Trans-Sahara line was estimated at $32,000 per mile, exclusive of electrification, which was considered necessary on account of lack of water. M. Fontaneilles estimates the present cost of construction at $96,000 per mile, with $32,000 additional for pipe lines to supply water for steam locomotives. Auxiliary expenses would make a grand total of $160,000 per mile, at normal rate of exchange.

Some Further Notes on Railway Electrification in Chile

With ample hydro-electric power available and a coal supply dependent largely upon importations the Chilean Government Railways in 1921 adopted a policy of electrification of the principal lines not only on account of operating economy but also to permit of increasing the traffic capacity by heavier loads and higher speeds than are practicable with the present steam locomotives. A contract was awarded for the equipment of the main line between Valparaiso and Santiago, 116 miles, and the 28-mile branch which connects with the narrow-gage Transandine Railway. These two lines have a gage of 5 ft. 6 in. The contract covers the overhead wiring, substation equipment and 39 locomotives, but current will be purchased from present hydro-electric plants. A note of this work was given in *Engineering News-Record* of Dec. 15, 1921, p. 976, but some additional information is given here in regard to the characteristics of the lines and their operation.

In crossing the mountains there is a 12-mile grade of 2.25 per cent against southbound traffic and a 6-mile grade of 1.81 per cent against northbound traffic. Curves of 10 deg. are numerous in the rough country. The track is laid with 80- and 85-lb. rails on Chilean oak ties mainly in stone ballast, but 75-lb. rails are used on the Los Andes branch. In the six tunnels, three of which are on the 2.25 per cent grade, the headroom is ample for the new electric equipment. Transmission lines from the hydro-electric plant will serve five substations delivering 3,000-volt direct current to the trolley wire. The catenary suspension system is used, with a $\frac{3}{8}$-in. cable in spans of nearly 200 ft. between the poles, carrying the trolley wire at a height of $19\frac{1}{2}$ ft. above the rails, except in the tunnels.

Pantagraph collectors on the locomotive will take current from this wire. Regenerative braking will be used on the express passenger engines and the freight engines, but not on the local passenger engines as these will not operate over grades heavy enough to make this equipment advisable.

Through passenger trains on the main line range from 200 to 300 tons behind the tender, and the heavier trains require pusher engines or double headers on the heavy grades, but the 126-ton electric locomotives are designed to handle these trains without assistance and at higher speeds. The present time of the fastest trains is 3 hr. 40 min. but it is expected to reduce this to 3 hr. 15 min. for the 116-mile run. The lighter engines for local trains will handle loads of 260 to 350 tons on the main line and 300-ton trains on the Los Andes branch.

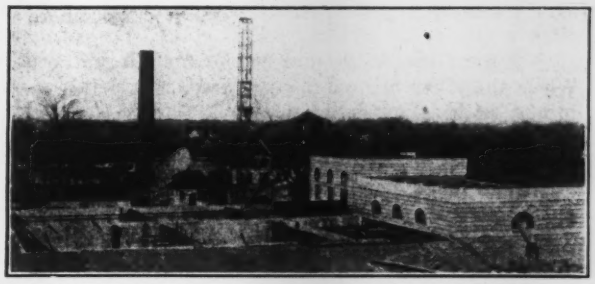
For a daily tonnage averaging 3,600 tons each way the freight trains generally weigh about 550 tons behind the tender and require pusher engines on the heavy grades. But the 112-ton electric locomotives are designed to handle 770-ton trains, requiring pushers only on the long grade of 2.25 per cent. In this way the present number of trains will be reduced about 25 per cent, while handling the same amount of traffic and at higher speeds.

This electrification contract was awarded to the Westinghouse Electric Manufacturing Co., Pittsburg, Pa., at about $7,000,000.

New Water Purification Plant for Topeka, Kansas

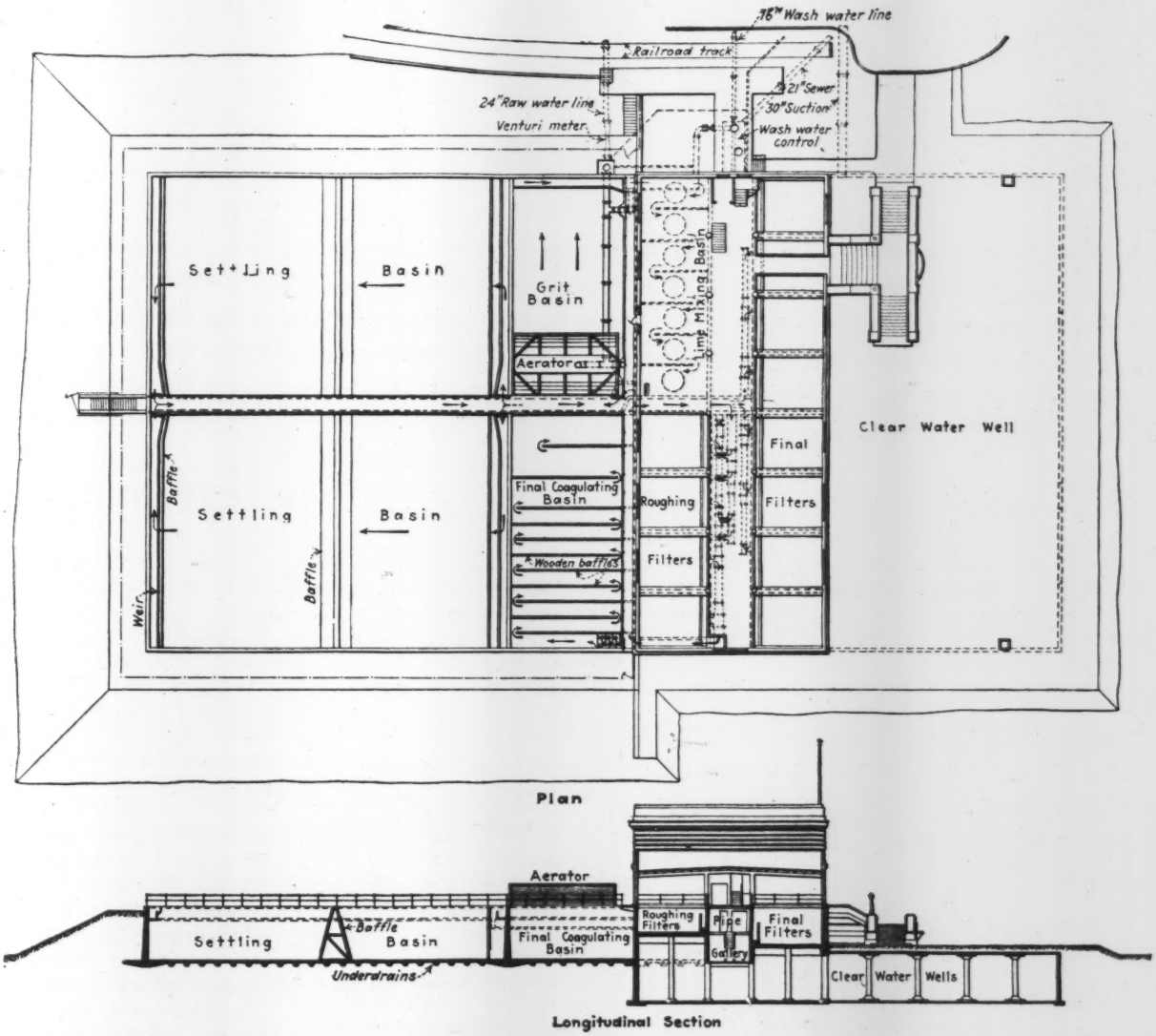
Eight Steps in Treatment-Aerators, Grit Chamber, Settling Basins, Roughing and Final Filters, Lime, Alum and Chlorine

ROUGHING filters of the same form as the final filters, underdrained settling basins and multiple-pan aerators are features in the new 8-m.g.d. water purification plant of the Topeka, Kan., water-works recently put into operation. The works will settle, soften, coagulate, double filter and chlorinate the Kaw River water supplanting a harder, insufficient well-water which had previously been purveyed. Before starting on the purification program exhaustive studies following examinations of both river and well supplies were made. The conclusion to treat the turbid river water was reached mainly because of the limited quantity of water further well development would produce economically, the greater cost necessary to soften it and the necessity for a tunnel to carry the water under the river.



NEW WATER PURIFICATION PLANT FOR TOPEKA

Although the river water is not so hard as the well water, ranging from 120 to 580 p.p.m. with a mean of 250 p.p.m. of total hardness, it still needs softening, and in addition the turbidity, which ranges from 13 to 3,385 p.p.m., must be eliminated. The total relative



GENERAL PLAN AND SECTION OF TOPEKA WATER PURIFICATION PLANT

cost per million gallons of treatment of the two supplies, exclusive of high-service pumping, was estimated at $40 for river water and $62.50 for the well water. While the river fluctuates considerably in depth at the intake, with an ordinary suction lift of 20 ft. the low-water flow has only once reached a minimum flow of 60 m.g.d.

Topeka has a population of 52,000 and uses only 70 gal. per capita, as it is fully metered. The average daily consumption in 1920 was 3,600,000 gal. with a maximum in July of 4,700,000 gal. It is expected that the filtered water will lead to an increase in consumption both on account of its better quality and its unlimited supply. A nominal 8-m.g.d. plant was constructed with filter equipment installed for 6 m.g.d. The grit, coagulation and settling basins were constructed for 10-m.g.d. ultimate capacity.

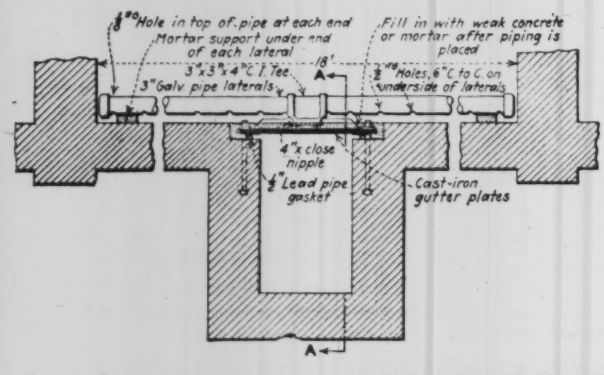
The plant consists of a double-chamber concrete intake pier, pan aerator, grit chamber, baffled lime mixer with motor-driven agitators, underdrained set-

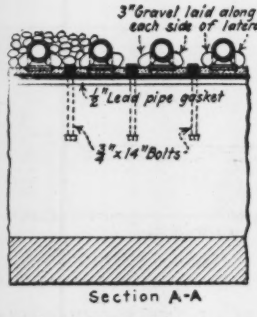
FINAL FILTER PERFORATED-PIPE UNDERDRAINS

tling basin, high-velocity wash roughing filters, coagulant basin, final filters, a 2,000,000-gal. clear well, chlorine plant and an elevated steel wash-water tank.

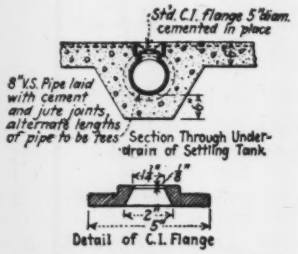
The intake is founded on shale rock 32 ft. below normal low-water level and is connected to the shore by a 124-ft. steel foot-bridge. Duplicate openings with sluice gates are provided with bottoms 6 and 4 ft. below and 8 ft. above normal low water. The capacity of the intake, 8 m.g.d., was determined by the size of the intake gates, which will pass 10 m.g.d. at a velocity of about 1 ft. per second. Two 24-in. cast-iron pipes carry the water to low-service centrifugal pumps which lift it to the aerator where the elevation is 21.25 ft. above the normal level in the clear well.

Multiple-Pan Aerator—The aerator consists of a series of steel pans, 3-in. deep, set one above the other,


⅛" Hole in top of pipe at each end
Mortar support under end of each lateral
Fill in with weak concrete or mortar after piping is placed
3"x3"x4" C.I. Tee
18"
½" Holes, 6" C. to C. on underside of laterals
3" Galv. pipe laterals
A
4" x close nipple
½" Lead pipe gasket
Cast-iron gutter plates
A



DETAILS OF UNDERDRAIN FOR ROUGHING AND FINAL FILTERS


Std. C.I. Flange 5" diam. cemented in place
8" V.S. Pipe laid with cement and jute joints, alternate lengths of pipe to be Tees
Section Through Underdrain of Settling Tank
1½" x ⅛"
2"
5"
Detail of C.I. Flange

SECTION THROUGH UNDERDRAIN OF SETTLING BASIN

giving drops of 15-in. each at the top and 18-in. at the bottom. The total length of weir is 900 ft., giving a nappe of 3½-in. or less, or 0.026 sec.-ft. per foot of weir, which is in accordance with the tests made by C. C. Young at Excelsior Springs, Mo. (see *Engineering News*, March 2, 1916). The lower trays provide more drop than those at the top so as to insure a free circulation of air. Tests have indicated an increase in dissolved oxygen of from zero p.p.m. to saturation with several aerators of this type constructed elsewhere, and reductions of CO_2 as much as 60 per cent.

A grit chamber having a nominal capacity of one hour effects a horizontal velocity of 1.16 ft. per minute. It follows the aeration. At the rate of 8 m.g.d. the lime mixers will retain the water for 0.5 hour and the forward velocity, maintained by cement-plastered metal-lath baffles, will be 4.65 ft. per minute. The lime will be thoroughly mixed with the water by motor-driven agitators.

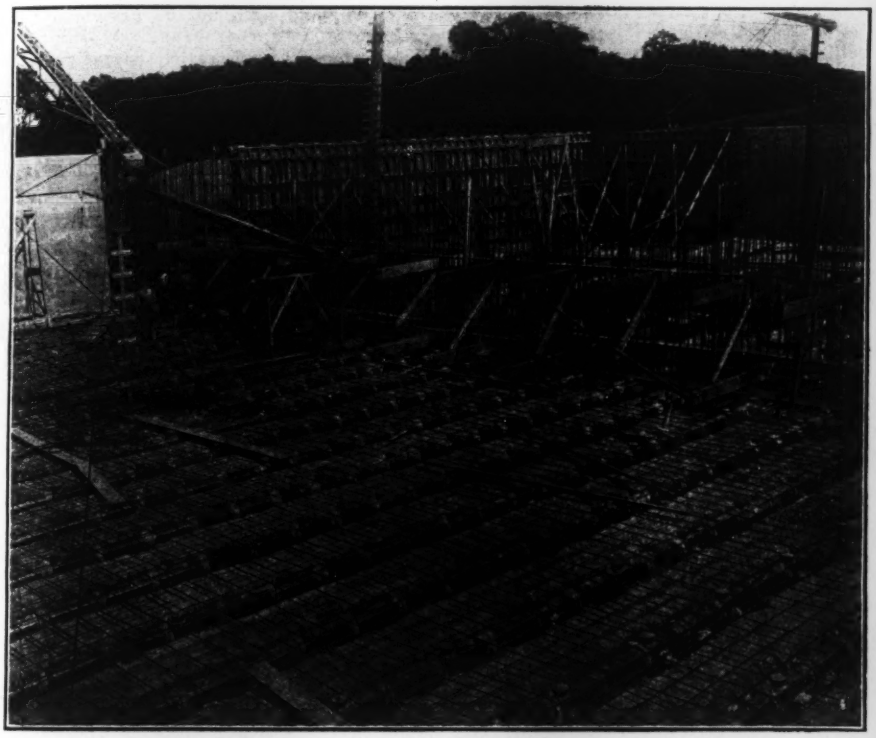
The 6-hour settling basin has a cross-section of such dimensions as to produce a nominal velocity of 0.32 ft. per minute. Since the basin is to remove the heavier sediment from the lime treatment and must handle a heavy load, a series of 8-in. vitrified-pipe underdrains are buried in the floor and have 1¼-in. openings in the concrete spaced at the corners of 5-ft. squares. If the mud angle of repose is as steep as 1 to 2 the maximum depth at the center of the squares will be but 15 in. The 5-ft. spacing is the same as used in similar basins at Lawrence and Emporia, Kan. The relation of the opening in the concrete to the area of pipes is 0.363. It is planned to open the valves on the end of each underdrain for a few seconds each day.

Diaphragms in this basin are for stiffening and were calculated on the same basis as stiffeners at bridge portals, with the steel stressed considerably higher than is usual. The filling rate is controlled by two 8 x 12-in. openings which will permit a maximum rate of 4 m.g.d. each, making a head of 1 ft. only possible on the baffle.

Roughing Filters—In the roughing filters, which have the same construction and same type of underdrains as the regular rapid filters, 18 in. of Joplin chats passing a ¼-in. mesh screen have been placed. The chats are supported on gravel layers made up of the same size and thickness as in the final filters noted below. The rate is 250 m.g.d. per acre, double the ordinary rapid-filter rate. The chat filters present points of contact on which the after-deposits of carbonates may collect, as well as remove further sediment and the chemical precipitate. Expe-

rience at Lawrence with chats as a roughing filter material indicated that after-deposits could be eliminated. That plant lacked sufficient washing facilities to keep the roughing filters in good working order, so it was decided in the Topeka plant to duplicate the washing facilities of the regular filters.

Final Filters—The final filters are of the conventional type, 18 x 20 ft. in plan, with underdrains of 3-in. galvanized perforated-pipe laterals, spaced on 12-in. centers with ½-in. holes on the under side spaced on 6-in. centers. The ratio of length to diameter of laterals or L/D=36 and the ratio of orifice opening to filter area is 0.502, the size being increased largely because of the high rate of filtration through the roughing filters and the high rate of wash, 2 ft. per minute vertical rise. These figures are in line with the Sacramento experiments but are higher than have ordinarily been used. The U-shaped concrete wash-water troughs are spaced 4.5 ft. from weir to weir. Sand was prepared on the job from that found nearby in the river. As placed in the filters it had an effective size of 0.4 m.m. and a uniformity coefficient of 1.6. The depth of the sand is 30 in. The distance from the surface of the filter medium to the wash-water weirs is 20 in. in both roughing filters and final filters. The supporting gravel has the following thickness and sizes: Up to top underdrain pipe laterals, 2½ to 3 in.; 5 in., 1¼ to 2½ in.; 3 in., ¾ to 1¼ in.; 3 in., ½ to ¾ in.; 3 in., ¼ to ½ in.; 4 in., 10-mesh to ¼ inch.



UNDERDRAINS IN SETTLING BASIN BEFORE CONCRETING
Wooden plugs in holes will be knocked out after construction is completed

Between the roughing filters and the final filters is a coagulant basin holding a supply of one hour. A stirring velocity of 0.75 ft. per second is maintained in a baffled section from which the water slows down to 9.4 ft. per minute at the beginning of the settling portion of the basin. At the end the speed is still further reduced to 4.7 ft. per minute.

The Topeka purification works were designed and the construction carried out under the direction of Black & Veatch, consulting engineers, Kansas City, Mo. C. I. Dodd was the resident engineer. The Unit Construction Co., St. Louis, Mo., held the general contract.

Costs of Steel, Concrete and Brick Stacks

Relative costs of smokestacks for power plants up to 600 hp. are given in the report of the committee on modernization of stationary power plants at the annual meeting of the American Railway Association (Mechanical Division). The accompanying table and notes are summarized from this report:

Steel stacks increase in cost directly in proportion to the boiler horsepower of the plant, this being due to duplication of stacks for the larger plants. The cost is much lower for small plants, but gradually approaches that of concrete and brick as the size of the plant increases. Concrete stacks decrease in cost per boiler horsepower as the size of the plant increases, the cost being slightly higher than that of brick for the same size of plant above 500 hp., and less for plants below 500 hp. Brick stacks also decrease in cost per boiler horsepower as the size of the plant increases, but in greater proportion, the cost being slightly less than that of concrete for the same size plant above 500 hp. and more when below 500 hp.

Maintenance and depreciation amount to 2½ per cent of total cost for concrete stacks per year, 3 per cent for brick stacks and 16 per cent for steel stacks. This may be variable, depending upon local conditions, design and proper maintenance, but appears to represent a basis of comparison which is comparatively accurate. There is practically no appreciable upkeep to a concrete stack. Brick stacks require pointing up from time to time, while steel stacks require painting annually or bi-annually.

COST OF SMOKESTACKS

Top Diam., In.	Height, Ft.	Boiler, Hp.	Cost Dollars	Cost Per B.H.P. Dollars	Annual Maint. and Depreciation
		STEEL			
34	85	150	569	3.79	91.00
36	75	150	600	4.00	96.00
38	90	200	758	3.79	121.00
34	85	300	1,138	3.80	182.08
		BRICK			
42	100	200	2,900	14.50	87.00
Average		200	2,750	13.75	82.50
54	100	400	3,100	7.75	93.00
Average		400	2,950	7.37	88.50
66	100	600	3,300	5.50	99.00
Average		600	3,150	5.25	94.50
		REINFORCED-CONCRETE			
42	70	200	1,675	8.37	41.87
Average		200	3,492	12.46	62.29
54	106	400	2,450	6.12	61.25
Average		400	2,883	7.21	72.08
66	100	600	3,400	5.66	85.00
Average		600	3,233	5.38	80.83

Propose Interstate Agreement on Reciprocal Licensing

State Engineering Examiners Will Consider Plan for Recognition of License in Other Than Issuing States

ARTICLES of agreement as to reciprocal registration of engineers have been formulated by the reciprocal registration committee of the Council of State Boards of Engineering Examiners and will be submitted to the Council at its next regular meeting in October with the recommendation that they be adopted and put into effect by the several state boards of engineering examiners.

In view of the fact that several states have separate license laws for engineers and architects, and that in some cases the license laws apply only to surveyors, the committee did not attempt to formulate a uniform reciprocal standard for either architecture or surveying, but confined itself strictly to professional engineering. An engineer applying for reciprocal registration must be licensed in some state which is a Council member.

The committee was unanimously of the opinion that the standard for reciprocal registration should be set so high that it will be considered a credit to any engineer to have reciprocal registration. It invites attention to the fact that the method of reciprocal registration provided does not conflict with any state law but asks by mutual agreement an additional recognition without cost.

Present membership in the Council of State Boards of Engineering Examiners includes Colorado, Florida, Illinois, Indiana, Iowa, Louisiana, Michigan, Minnesota, North Carolina, and Oregon.

The proposed articles of agreement are as follows:

Article 1.—Qualification for reciprocal registration shall be determined upon the basis of professional record, thorough consideration of which shall constitute examination.

Article 2.—Engineering experience gained by the applicant prior to his reaching the age of 18 years shall not be deemed of sufficient importance to be counted as a part of such professional experience.

Article 3.—Applicant's professional experience shall be considered as beginning when he emerges from the apprenticeship, or artisan class, into a position which requires original thought and responsibility.

(a) In civil engineering, experience shall begin at the point where the applicant reaches the responsibility of, or equivalent to, that of actual transitman.

(b) In other branches of engineering, experience shall count only after apprenticeship, foremanship, inspectorship, or other subordinate positions, unless the work done specifically shows that the applicant possesses originality of design and has had responsibility in his subordinate positions.

(c) In the drafting room, experience shall begin to count at the point where the applicant ceases to do merely tracing, lettering, or purely mechanical work, requiring for its performance only manual dexterity, and enters a position of responsibility where he begins actual design.

Article 4. — The applicant shall show ten years of experience of the character indicated above as evidence of qualification for reciprocal registration, and his experience record shall show progressive advancement in the character of the work performed, without disqualifying evidence. Each case shall be considered on its merits, and the experience record must be given in such complete detail that the Board of Examiners can accurately determine the class of work performed by the applicant.

Article 5. — Graduation from an engineering school of recognized standing shall be accepted as the equivalent of two years of such practice. The intent of this clause is to recognize engineering schools which exact the equivalent of a high school or a preparatory school diploma as an entrance requirement, and demand the equivalent of a four years course in engineering for graduation.

Article 6.—Where the experience record of an applicant shows that he has done exceptional work of much higher character than that implied in Articles 3 and 4, he may be granted reciprocal registration upon a record of seven years experience, of which graduation from a recognized school of engineering shall count as two years.

Article 7. — The submission of a detailed professional record, properly attested, and accompanied by references as to character and qualification from three reputable, registered, practising engineers, shall be considered as the equivalent of examination, and need not be presented by the applicant in person.

Article 8.—Making reciprocal registration operative between the states shall be done by means of certification from one state to another of the applicant's qualification, and by the affixing to the license or registration certificate, renewal certificate, or annual card, of a seal, which shall bear the name of the board of examiners issuing same, together with the words "Reciprocal Registration." This seal shall be in addition to any other seal required by state law to be affixed to such papers.

Article 9. — Whenever an applicant applies to a state board for registration, if his qualifications fully comply with the standard for reciprocal registration herein provided, he shall be entitled to the reciprocal registration certificate and seal. Those who have previously been granted registration in their own states, upon applying for reciprocal registration, shall be granted same, if fully complying with the standard herein provided.

Article 10.—The aforesaid reciprocal registration certificate shall be prima facie evidence of qualification for license in any state, member of this council. Upon presentation thereof, together with the legal fee required and such information (other than evidence of qualification) as may be requested for the records of the board to whom the application is made, such board shall issue license or registration to the applicant.

Article 11. — Any reciprocal certificate may be revoked by the state issuing same upon presentation to its board of examiners of good and sufficient evidence of gross incompetence or that the applicant's character warrants such revocation.

Article 12.—Should any questions or disagreements arise, or should any points in the above agreement appear to require interpretation, such questions shall be referred to the Council for action at its next regular meeting; or in case more expeditious action shall be necessary, they may be acted upon by the Council by letter ballot. If by letter ballot, such ballot shall be conducted through the office of the secretary of the Council in the customary manner, and the votes shall be counted not later than sixty days after forwarding from his office, by registered mail, of the questions at issue. The secretary of Council shall thereupon immediately certify to the various member boards the roll call and results of the vote, and the determination of the questions at issue, and consequent action shall be in accordance with the majority of the votes recorded.

Plan Railway Extensions in China

Extension of the Peking-Suiyuan Railway 100 miles farther west is about to be begun, according to an article in the *Peking Leader* forwarded by the United States commercial attaché at Peking. The survey for this line had been finished for some time and most of the grading completed when financial stringency compelled a suspension of work. This is the first Chinese line to be built entirely by native engineers. It was originally estimated to cost $6,746,000 but under present plans a temporary type of construction will be used lessening the cost.—*Commerce Reports.*

Completion of Barrett Dam Wins Close Race With Water

For Months Steadily Rising Reservoir Threatened to Overtop Structure—Value of Water Saved Exceeds Cost of Dam

SOURCES OF WATER supply serving the city of San Diego are being developed and additional reservoirs are being provided to store enough water to fulfill the city's rapidly increasing requirements over a period of several years of subnormal rainfall. Temperature and aridity conditions in that region are such that the evaporation from open reservoirs is about 5½ ft. per year, thus adding materially to the storage requirements. The latest addition to the system is the Barrett Dam, just completed, which was built to store water on the Cottonwood River about 36 miles east of San Diego. This work has required the excavation of 75,000 cu.yd. of material and the placing of 140,000 cu.yd. of masonry. The construction layout used on Barrett Dam was described in *Engineering News-Record*, Oct. 27, 1921, p. 695.

DAM CREST DURING THE RACE WITH HIGH WATER

Note that the water is being held back by the weight of freshly poured concrete held by cribs in the form of piers between which panel-forms serve as flash boards. The downstream side at times was below reservoir level.

The rainfall in the city of San Diego for the month of December, 1921, was 9.26 in. and for a 24-hour period during December 25-26, it was 3 in. These exceed all previous records for 30-day and 24-hour periods respectively. Unusually heavy rainfall continued in the vicinity of San Diego for the spring months of 1922, bringing the total precipitation for the winter of 1921-22 to about 200 per cent of normal; the second heaviest in seventy-five years. This came after a flood-producing storm at the beginning of the season and fortunately was distributed uniformly over a period of five months.

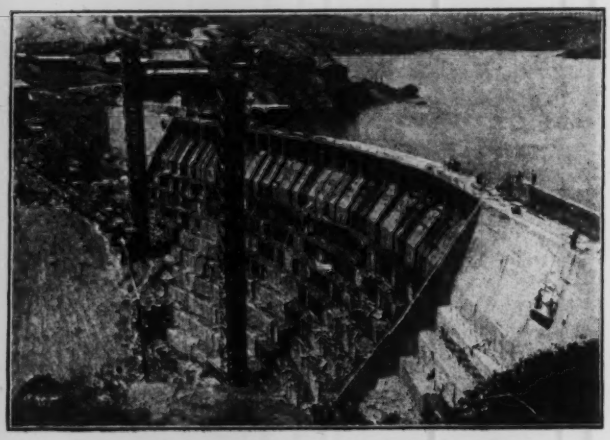
At the beginning of this five-month period work was well advanced on Barrett Dam and enough concrete had been poured to bring the structure above the level of the storage required in the reservoir to hold an average season's full run-off. The first heavy run-off of the winter immediately increased the level of the water in the reservoir from El. 50 ft. to 106 ft. From that time on the level of water in the reservoir raised at the maximum rate it was possible to bring up the concrete structure. By concentrating every effort on the work plus remarkable good luck, no water was lost and in addition to retaining all the run-off that came from its own drainage basin, Barrett Dam took care of 1¼ billion gal. that overflowed from Morena reservoir which is farther up in the same drainage basin.

Figured on the wholesale rate of 10 cents per 1,000 gal. plus the pumping cost and fixed charges which the city has been paying for unfiltered water to supplement its own supply, the value of the water stored behind Barrett Dam by the time the structure was completed exceeded the entire cost of the dam. However, loss by overflow during construction would have been much more than the value of the water in dollars and cents. Overtopping at any time during the last five months of the work would have put out of commission the concrete hoisting and spouting system and flooded the sand pits, thus probably making it impossible to complete the dam this season and losing the opportunity to create and utilize the full storage capacity for this season's run-off.

With construction going on under these conditions any risk of mere plant, materials or fresh concrete was

considered justifiable if it enhanced the prospects for keeping the dam above the rising water level. Except for the loss of freshly poured concrete there was little or no risk of damage to that part of the structure already completed because both ends were advanced as soon as possible and kept above the center so that in the event of an overpour the abutments would be protected. In anticipation of emergency requirements a number of temporary sluiceways fitted with stop planks were maintained continuously through the central portion of the top of the structure as the masonry was carried up.

From Dec. 26 to the completion of the work some five months later, the reservoir level not only kept up on the stop planks in the sluiceways and was continuously very close to the crest of the uncompleted structure but repeatedly and frequently threatened to overtop it and during practically all of the time was higher



BARRETT DAM COMPLETED TO FULL HEIGHT
"Stepping" the downstream face saved labor by (1) making workmen more efficient than when working on the face of a sheer drop and (2) facilitating crossing at any level.

than some sections of the uncompleted masonry. Overpour at times was prevented only by upstream forms backed up by a little fresh concrete hurriedly placed and sloping rapidly down and away from the forms to a level 10 ft. below that of the water in the reservoir. At other times when the crest of the uncompleted dam had been brought up, as was the general practice, a few feet higher on the downstream side than on the upstream side the impounding water actually came up on to and part way across the top of the structure. At such times the concrete that was placed with feverish haste on the upstream half of the crest to keep the dam above the rising water level, had to be deposited under water.

Because of the necessity for concentrating time and effort on more essential work, form panels often had to be set up hastily and left without being aligned to a nicety. About one-third of the upstream panel forms were lost by being submerged before they could be removed. These, however, were considered mere incidentals in the consummation of the main objective of saving the water.

One of the factors that increased the risk of losing the race was the difficulty in delivering cement to the job. Despite the fact that there were 10,000 bbl. of cement stored at the dam when the rainy season came on (all available cement storage space being filled) there was a shortage of cement for several weeks during the critical period. This was because the 14-mile road over which cement normally came from the railroad by motor truck became impassable after several weeks of unusual and unexpected rainfall and another route 25 miles long had to be used. There were times during the critical period when all the trucks available, loaded with cement, were stuck in soft spots along this 25-mile route.

The rainfall at Barrett Dam was 33.2 in. in the five-month period. The good fortune of the equable distribution, together with the success in keeping the dam above the rising water level, has put the city in an unusually favorable position in regard to quantity of stored water. In addition to the 12½ billion gal. now stored in Barrett reservoir, Morena, Upper Otay and Chollas Heights reservoirs are completely filled, and Lower Otay practically so, bringing the total amount of water stored in the city's system to over 42 billion gal.

The construction of Barrett Dam has been under the direction of H. N. Savage, hydraulic engineer for the city of San Diego. W. A. Stebbins was construction engineer resident at the dam.

Summing Up the Ford Proposal

Extract from the majority report of U. S. Senate Committee on Forestry and Agriculture on the various offers for the water-power and nitrate plants at Muscle Shoals on Tennessee River.

THE wonderful propaganda that has been carried on over the country in favor of the Ford offer has led the people to have an entirely erroneous idea as to what the Ford offer really is. It is difficult to harmonize our idea of Mr. Ford's fairness with his silence on this subject, when his name is so often used in exaggeration and misrepresentation as to just what he does offer to do. The country has been given to understand that Mr. Ford has guaranteed to reduce the cost of fertilizer by one-half. He has done nothing of the kind. He has made no guarantee of any kind in the way of the reduction of the cost of fertilizer. The country has been given to understand that he pays the Government 4 per cent interest on its investment in the two dams. He does nothing of the kind. He has not made any such offer and no such proposition is included in his bid. Giving his corporation credit for every dollar that it pays, he will be paying to the taxpayers less than 3 per cent on the money which he uses out of the Treasury of the United States, and when we consider that this loan runs for one hundred years, it requires even the stretch of the imagination to understand the enormous profit that his corporation secures in this one item alone.

Assuming that a fair interest rate in the commercial world is 6 per cent, this would give his corporation during a hundred-year period a total gift of cold cash of $236,250,000, and if this money were compounded as Mr. Ford asks the Government to compound what he pays, the profit to the corporation at the end of the one hundred-year period would be $14,500,000,000. This is more than half our total cost of the World War.

The country has been given to understand that the Ford offer provides for the repayment to the Government within the one hundred-year period, the entire investment that the Government has made. His offer does nothing of the kind. On the other hand, the total payments include in the offer of both interest and amortization, amount to less than 3 per cent on the investment and he never pays one dollar of the principal. The people of the country have been led to believe that the Ford offer means a reduced price for electricity to consumer. It means nothing of the kind. He has not agreed to furnish a single kilowatt to any home or to any manufacturing concern except his own. The great city that is to spring up as if by magic will probably have its streets and its homes lighted by electricity, gen-

erated from coal that is shipped in on the railroads. The mighty power at Muscle Shoals will be devoted entirely and exclusively to the use of the great corporation which Mr. Ford will organize.

When we bring together the results that must follow from these two divisions of the Ford offer, the mind is dazed at the unreasonableness of the proposition, at the enormity of the gift. With the expenditure of no money, there is turned over to a corporation property of the value of more than one hundred million dollars, and the right and privilege to extort unjust profits from the citizens of this country without limit. Money is furnished by the unwilling taxpayers of the country to construct improvements of millions in value and to finance operations on the most gigantic scale in history, not for the benefit of the people, but entirely and exclusively for the benefit of one corporation. The inheritance of our children and our children's children is mortgaged, and the resources of our country are not only given away, but with the gift is tied up cheap money, obtained at the expense of the taxpayers, and the right to use it with but little recompense, for one hundred years' time. There is nothing in the history of the world with which this can be compared. Civilization is without a precedent. If the Ford offer is accepted, then the fight for conservation that has been waged by public spirited and patriotic men and women all over the country is not only lost and given away, but those who are unwillingly compelled to make the gift are to be taxed one hundred years to make the gift more profitable. It is the greatest gift ever bestowed upon mortal man since salvation was made free to the human race.

Bark Left on Underground Part of Creosoted Piles

IN THE new State Pier being built by the Directors of the Port in Portland, Maine, (*Engineering News-Record*, April 27, 1922, p. 691) the piles forming the main part of the substructure are being furnished with the bark on for the bottom 30 ft. so as to save in the cost of creosoting. The specifications in this particular read as follows:

"The bark and inner skin shall be removed except for a distance of 30 ft. from the tip. . . . Each pile shall be so treated as to contain not less than 16 lb. of creosote oil per cubic foot of the peeled portion of the pile unless the engineer is satisfied that the largest practicable volumetric injection has been obtained with a lesser amount of oil."

In explanation of this, Fay, Spofford & Thorndike, the engineers for the pier, say:

The above specifications are for southern yellow pine, either long-leaf or short-leaf, and are applicable to approximately 5,500 piles of which 2,200 are from 85 to 89 ft. in length and 1,500 of the remainder are over 70 ft. in length. The object of the specification was primarily to reduce the amount of creosote required to impregnate the pile, the bark acting as a partial barrier to the impregnation of the creosote on the portion of the pile which is to be driven into the ground and which would, therefore, be free from the attack of the limnoria which are, so far as known, the only marine worms giving trouble in Portland harbor. The expense of the creosoting is a highly important factor in the total cost of the piles—about one-half of the total cost of the piles as delivered at the shipping point. There would also be a minor saving resulting from the fact that the bark would not have to be peeled from this portion of the pile.

In carrying out the provisions of these specifications, it was necessary, in order to determine the proper amount of treatment to ensure 16 lb. of creosote per cubic foot in the peeled portion of the pile to make an assumption as to the amount of creosote penetrating the bark. This figure was agreed upon in conference with the creosoting companies as 4 lb. per cubic foot. No exact knowledge, however, exists on this point and it seems to me one which might well be investigated by the Committee of the National Research Council now engaged in the study of the activities of marine worms. We estimate that this provision of the specifications has saved upwards of $10,000 in the cost of the piles for this job.

Restoring a Fire Damaged Concrete Building in Berlin

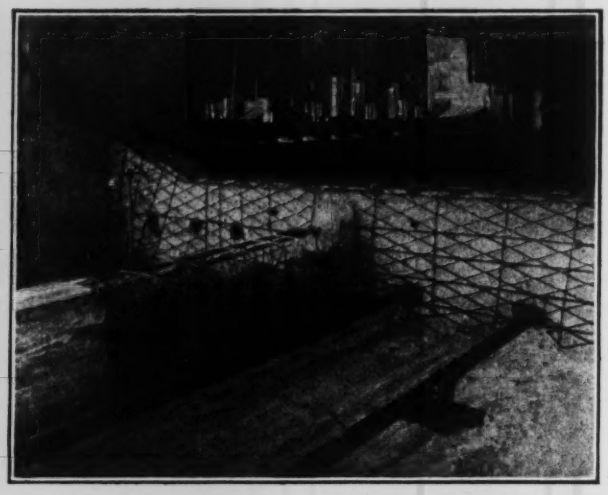
Spalled Reinforced-Concrete Columns and Beams in German Chocolate Factory Re-covered by Cement Gun

AS noted in *Engineering News-Record*, May 11, 1922, p. 795, last January one of the factory buildings of the Sarotti Company, a large chocolate and cocoa manufacturer in Berlin, Germany, was severely dam-

REPAIRING COLUMNS IN BERLIN FACTORY

Column in foreground has been stripped of damaged concrete, new reinforcement placed and gunite applied to lower half. Man applying gunite in rear.

aged by an interior fire which gutted the building of its contents and wrecked a number of the reinforced-concrete members. The building in which the fire took place, as noted in the other article, was five stories high, a beam and girder reinforced-concrete building of an outside plan of 255 x 180 ft. with an interior court about 50 x 70 ft. It was filled with highly combustible material and the fire communicated to each of the five floors through a central well. Damage to the concrete structure was mainly in the spalling off of the concrete over the reinforcement. This spalling varied somewhat with the size of the members but in practically every case the concrete was destroyed to at least the depth



BEAM AND GIRDER CLEANED FOR GUNITE COATING

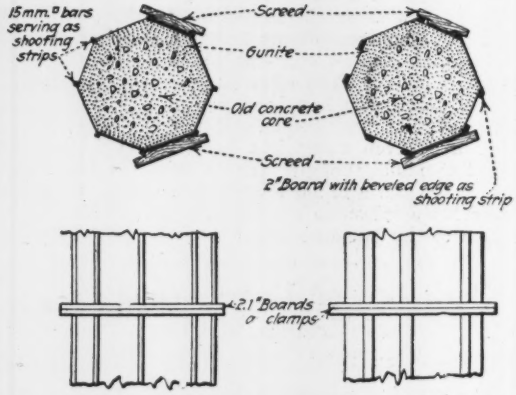
of the steel and in many cases to a point back of the steel. The full extent of the damage to the concrete was not all discovered until repair was started and then it was found necessary in some of the larger columns to add 12 in. of concrete, and in about half of them 6 in.

In the reconstruction work, which is now under way, the new concrete was applied with a cement gun. Two standard type N-1 cement guns were used on the work, each located in approximately the center of the length of the building but on opposite sides of the interior

SHOOTING AND SCREEDING STRIPS IN PLACE

court. A separate electrically driven air compressor was provided near each machine and with each gun was about 300 ft. of delivery hose. Cement and sand were dumped into the basement and on the first floor level close to each machine and all the shooting to whatever part of the building was done from the one location of the gun. A total difference of elevation of 120 ft. was taken care of.

The general method followed was similar to those followed in this country for the repair of the Edison buildings at West Orange and the warehouse at Far Rockaway, L. I. That is, the spalled concrete was first removed by hammer and later by an air tool until sound concrete was reached. Where the reinforcement had been destroyed by fire additional reinforcement was added, and in the case of the columns and the larger



DETAILS OF SHOOTING STRIPS AND SCREEDS

girders new reinforcement to hold the gunite was placed. In the columns this consisted of vertical rods varying in size from ½ to 1 in. long and hoop reinforcement of ¼ in. wide spaced 4 to 6. One of the views shows a column half covered with the gunite and the reinforcement in place.

The first application of gunite was made of a thickness just to cover the reinforcement. After putting on this first application shooting strips, as shown in the accompanying sketch and illustrated in one of the photographs, were placed and a second layer of gunite applied as shown. In the beams the old stirrups were used as supports for reinforcing the gunite and new stirrups of round iron fastened to the old and the expanded metal fastened to the new stirrups.

The beams and the underside of the floor slabs were cleaned after the loose material was removed with hammer and chisel by using a cement gun as a sand-blast machine. First this cleaning was done by hand, using wire brushes, but trials proved that the cement gun would do the work in about a quarter of the time.

The work was started April 4, 1922, and up to and including June 3, or 40 days, the cement guns were in operation 375 hr. moving 2,160 cu.ft. of cement, 353 cu.yd. of sand at an average mixture of 1 to 4½, which means about 4.5 cu.yd. of concrete placed a day of 4.7 hours. The crew for the work consisted of one foreman, one compressor operator, two nozzle men, two laborers and gun operators and 12 laborers wheeling sand and cement, mixing and screening sand and cement.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

From Another Engineer's Wife

Sir—Referring to recent letters from engineers' wives published in your valuable columns, here's an incident that happened to my husband at a hotel table in a small Wisconsin town. My husband is a pretty well known bridge engineer. In the course of conversation with an inquisitive elbow mate, he was asked,

"What business are you in?

"I'm a civil engineer.

"What's that?

"I'm a bridge builder.

"Oh! I see, a sort of a carpenter?

"No! a card player"—and it went.

SIC SEMPER.

Some Questions as to the Oregon City Arch

Sir—The article in your June 8 issue, p. 942, by C. B. McCullough on the Oregon City Bridge brings to mind several interesting questions on design.

The author lays much stress on the injurious effects of the sulphite fumes from the paper mills, which are some 600 ft. distant. The old suspension bridge occupied the same site for the past thirty odd years and did not show excessive corrosion, either on the galvanized cables or the rod hangers. True, the cables became somewhat corroded near the anchors, probably due either to electrolysis or rusting from soil moisture. These points were better protected from the fumes than any other parts of the cables. Nearby vegetation shows no injurious effects from atmospheric pollution. Any structural steel exposed to the Oregon climate should be painted at intervals of four or five years, and the writer does not consider that these intervals will be materially shortened by the proximity of the bridge to the paper mills. Hence the economy of this type of structure over a spandrel braced arch is not apparent.

The cross-section of the arch rib is the second point for consideration. Obviously the rib takes both flexure and direct compression. Why, then, should it not conform to the recognized specifications for both plate-girders and columns? The 6 x 3½ x ⅞ longitudinal angle stiffeners have a radius of gyration of approximately 1.75 including a portion of the adjacent web plate. This, for the maximum unsupported length of 17 ft. gives a ratio of L to R of 113. The specifications of the American Railway Engineering Association limit the length of unsupported flanges of compression members to 40 R. These angles are too slender to make effective stiffeners. The web plates in themselves are not thick enough to satisfy standard specifications for compression members. Hence the allowable unit compressive stress in the arch rib is limited by these unsupported portions and is much smaller than the rib taken as a unit.

Another point worthy of consideration is the fact that the lower ends of the arch ribs are under water for a major portion of the year, and as much as 15 ft. under water during ordinary spring run-offs. The 1½-in. coating of gunite on the exterior cannot be expected to keep all of the water out of the ribs. Neither will the concrete filling in the ribs adhere to the web plates to protect them from corrosion. An analogous case is one cited in *Engineering News-Record*, Feb. 10, 1921, p. 264 concerning the failure of an arch bridge at Dayton, Ohio, which showed that the concrete adhered to only about 15 per cent of the steel.

R. W. LINCOLN,
Consulting Engineer.

June 20, 1922,
Portland, Ore.

Tie-Treatment a Charge Against Capital

Sir—Referring to various articles in *Engineering News-Record* including that in the issue of June 1, 1922, p. 921, by Earl Stimson, chief engineer of maintenance, Baltimore and Ohio R.R. Co., and F. S. Schwinn, chief engineer, International and Great Northern Ry., and letter of June 9, by J. N. Sunderland, printed in your issue of June 29, 1922; all of these articles relate to the propriety of capitalizing the actual cost of cross-ties treatment.

According to the principles of economics this cost is a proper charge to the capital account. The classification of investment in road and equipment of steam roads, p. 18, Account 8, states: "This account shall include the cost of cross, switch, bridge and other track ties used in the construction of tracks for the movement or storage of locomotives and cars and the cost of additional ties subsequently laid in such tracks; also the excess cost of metal ties used in repairing of tracks over the cost to replace in kind wooden ties removed." The classification of operating expenses, p. 42, Account 212, states: "This account shall include the cost of cross, switch, bridge and other track ties used in the repairs of tracks."

There is no specific reference to the cost of treating ties in any of the classifications. However, the correct economic principle to be followed is to charge "renewals in kind" to operating expenses. It is understood that the bureau of accounts does not approve charging cost of treatment to investment where a few ties are used on each track section, but where a whole district or division has actually been renewed with treated ties it is probable that the bureau would carefully consider any reasonable case presented by a carrier, and approve a proper charge to investment provided the actual cost of treatment had been checked by a representative of the bureau, and the evidence clearly showed that the cost was in excess of the original investment. There seems to be general agreement that the cost of treatment of ties is a proper charge to capital account and the bureau of valuation during the past nine years has inventoried, classified and priced ties exactly as found in the track on the date of valuation.

EDWIN F. WENDT,
Consulting Engineer.

Washington, D. C., July 15.

Old Dams Being Inspected in Quebec

Sir—I was interested in the note published in *Engineering News-Record*, June 29, p. 1069, about the inspection of old dams in the State of New Jersey by engineers of the State Department of Conservation and Development.

An investigation of all dams situated in the Province of Quebec is also being made. The work, instead of being done by engineers of the Government, is left to the care of every proprietor. In 1918, three laws were enacted stipulating: (1) "That nobody (corporation, partnership, person) can begin any canal, flood-gate, embankment, dam, dyke, etc., in the water courses running through his property without having previously obtained the approbation of the Lieutenant-Governor-in-Council; (2) every possessor of existing works of this kind is obliged to submit plans and specifications of such works to the Minister of Lands and Forests; (3) all works to be done in the future for the storing of water must be previously authorized, if such works necessitate the taking possession and occupation of public or private property or affect the same in any way."

This covers every case which may exist regardless of the height of the dams, dikes, etc., or of the extent of the drainage area. We estimate that the number of existing dams for the floating of logs only about 1,800. Out of that number, the Department of Lands and Forests has received, since 1918, about 275 plans. We feel well satisfied with this result, considering that the financial situation of many lumber companies has been precarious of late. We have no serious difficulty in getting exact information.

EUGENE ROY,
Engineer, Department of Lands and Forests,
Quebec, Canada.

NEWS OF THE WEEK

New York, July 27, 1922

Connell to Advise Pinchot on Penn. Road Policies

Republican Nominee for Governor is Investigating All State Departments Before Election

A survey of the Pennsylvania State Highway Department has been undertaken to place information regarding fiscal, engineering and other policies in the hands of Gifford Pinchot, Republican nominee who, unless a political upset occurs, will be Pennsylvania's next governor. The investigation is being made through the agency of the Citizens' Committee on the Finances of the State of Pennsylvania, appointed by Mr. Pinchot. William H. Connell, formerly chief of the Bureau of Highways of Philadelphia, has been selected to canvass the state highway situation and submit a report. The survey will include a study of organization, engineering policies, and general conduct of the business of the entire department.

It is understood that Mr. Pinchot, in his capacity as candidate for governor, desires to have this information in hand before election so that, in the event of his choice as the state's chief executive, he will be familiar, at the outset, with the work and policies of the various departments under his jurisdiction. Through the Citizens' Committee, of which Dr. Clyde L. King is chairman, similar studies are being made of other state departments. Dr. King has made for *Engineering News-Record* the following statement in explanation of the committee's work:

PURPOSE OF SURVEY

"The last session of the state legislature in Pennsylvania appropriated at least $30,000,000 in excess of income to the state. The day after Mr. Pinchot was chosen as the Republican nominee for governor he appointed a Citizens' Committee to undertake a survey of the fiscal situation which the next legislature must face. The committee has adopted the policy of having a high-grade expert, the best available in the state or in the country, make a survey of the spending policies of each of the departments of the commonwealth. The idea is to investigate past practices and present situations as a basis for constructive recommendations for a budget, which, in the event of Mr. Pinchot's election, is to be submitted for the first time in Pennsylvania to the state legislature.

"Our whole purpose and plan is to place the expenditures of the state on a business basis. To make the highway survey we have chosen William H. Connell who will associate with him an advisory committee of engineers from outside the state. Mr. Connell made a notable record as chief of the Bureau of Highways in the Blankenburg administration (in Philadelphia). Mr. Pinchot wants to make a survey of the kind that would be helpful to a manager of a large business enterprise, private or public, in order to acquaint himself with the policies and the details necessary for handling his job from the day he lands in office. Most public administrators are educated by their job for their job, and learn it only about the time they are through their public service. Mr. Pinchot sets himself the task of learning about his job before he starts it."

FOR FOOTPATHS ALONG STATE ROADS IN NEW JERSEY

At the next session of the New Jersey Legislature an effort will be made, according to information received from T. J. Wasser, state highway engineer, to amend the State Highway Act in order to provide for the construction of footpaths along state highways. An unsuccessful attempt was made this year to have a bill carrying such an amendment passed. It is the opinion of the State Highway Commission that the footpaths are needed to reduce the number of motor-vehicle accidents to pedestrians. The wording of the proposed amendment to the State Highway Act is as follows:

"Proper footpaths for the use of pedestrians may be constructed on such portions of any state highway where, in the opinion of the State Highway Commission, such construction is necessary and advisable."

Knickerbocker Theater Indictments Thrown Out

Justice Siddons of the Criminal Court of the District of Columbia on July 24 dismissed the indictment for manslaughter against five defendants in the case of the roof collapse of the Knickerbocker Theater, Washington, on Jan. 28. The decision will be appealed to the District Court of Appeals. R. W. Geare, architect; J. W. Ford, steel designer and fabricator; J. R. Downman, building inspector; R. G. Fletcher, subcontractor; and D. M. Wallace, superintendent, were jointly charged with negligence in the indictment, as noted in *Engineering News-Record* of April 6, p. 582.

It is held in the decision that the facts in which the alleged offense of negligence consists are not set out in the indictment with reasonable certainty. The court pointed out that the indictment fails to allege in what respect the plans and specifications prepared by Geare were negligently prepared, and fails to show in what respect he failed to exercise the general direction and supervision of work on the theater; and similarly as to the other defendants.

Court Denies Infringement of Chuting Patent

Holds Callahan Patent on Chuting Apparatus Applies Only to Exact Combination Claimed

A lower court decision on the validity of what has been assumed to be a basic patent on concrete chuting apparatus was handed down by Judge Dickinson in the District Court of the United States for the Eastern District of Pennsylvania on June 13, 1922. The decision, while expressing some doubt as to the validity of the patent in question, does not rule against it, but it does rule that that patent applies only to the exact combination of devices claimed in the patent and on that basis the apparatus complained against was declared to be not an infringement.

The patent in question, U. S. 948,719, issued Feb. 8, 1910, on an application filed Jan. 21, 1909, to one Callahan and afterwards assigned to the Concrete Appliances Co., of Missouri, is for a concrete chuting device, denominated in the suit as an "apparatus for hoisting concrete to a hopper located considerably above the level of the work under construction or permitting it to flow through an inclined pipe to the point of delivery." The claims center around five elements in combination, that is, a tower, a hoist, a hopper, a boom and a conduit carried by the boom. The device complained against, which was used in the building of the Gomery & Schwartz automobile warehouse at 24th and Market Sts., Philadelphia, comprises a chuting tower with trussed chutes, one of them counterbalanced, and of two types, one of which is supported by a boom and the other in which the chute itself constitutes the stiffening horizontal member. Suit was brought by the Concrete Appliances Co. and William H. Insley against John E. Gomery, John C. Schwartz, Michael J. O'Meara and Concrete Construction Co.

The patent had been in litigation several times before, but the principal case was by the same plaintiffs against Meniken, Owens and Curd in Cincinnati. In this suit, decided in the district court, June 19, 1918, and upheld in the circuit court Jan. 6, 1920 (262 Fed. Rep. 958), the Callahan patent was upheld.

NEW EVIDENCE IN SUIT

New evidence as to prior art was advanced in the latter suit, and in recognizing this new evidence Judge Dickinson said: "We are not persuaded that the evidence before us so far differs from the evidence in the former case as to compel a different finding from that then made. We feel, however, that the defendant has a right to the expression of our conviction that had such finding of invention not been made, the evidence before us bearing upon the prior state of the art would have led us to the conclusion that no invention is disclosed by plaintiff's appliance, at least further than to confer upon him the right to a patent limited

to the specific special construction which the patentee devised."

The case then, according to Judge Dickinson, becomes not one of invention but one of infringement, and in investigating this phase the judge decides that the device complained against does not copy all of the details of the patent. For instance, he calls attention to the fact that the patent has claims for a separate conduit and boom, and that where the conduit serves itself as a boom, there is no infringement.

In laying down the general law in this case the judge says that "if an inventor goes to a prior art and takes therefrom five elements, which he puts together in a combination constituting a patentable invention, and another man goes to the possession of the same art and takes therefrom four of these same elements, of which he makes a combination, thereby creating an appliance which will serve the same purposes and do all the work of the first and do it equally well, the two appliances are not the same in a patentable sense. The invention is not in the elements nor in any one or more of them, but in the combination, and the combination is not the same but a different one. The inventions are likewise not the same but different inventions. . . .

"When those who practiced the art used appliances constructed of various combinations of these known elements, and all the patentee did was to devise a special make of apparatus constructed upon the principle of a combination of a given number of these known elements which has the merit of being a better appliance than those made up of fewer or other elements, all that the patent gives is a monopoly of that make of appliance. He cannot force the trade to use his superior make nor levy tribute upon it for the use of appliances which are not his appliance nor deprive the trade of the right before enjoyed of making appliances out of what the art supplied so long as the appliances which were thus made are not his appliance nor the equivalent of it. Chute conditions were in common use. They had to be supported or be constructed of sufficient strength to be self-supporting. Either was expensive and otherwise open to objection. The thought of a boom to carry the conduit was an advance. In many respects the construction was a better construction. This, however, gave the inventor of the construction no property right in a self-supporting conduit construction, and he does not get the right by calling the conduit a boom."

The decision was that the defendant had not infringed and that the bill should be dismissed for want of equity.

Decision in Bascule Bridge Suit

A suit brought against the Scherzer Rolling Lift Bridge Co. by the Strauss Bascule Bridge Co. on account of infringement of a patent has resulted in a decision favorable to the former company in the Federal district court at Chicago. Judge Page dismissed the case with a verbal statement to the effect that there was no evidence of infringement, but the Strauss company will appeal the case. The patent in question relates to construction of the shoe or bearing surface on the curved rolling heel of the bridge.

TRANSPORT PRIORITIES MAY DELAY ROAD WORK

Priority orders of the Interstate Commerce Commission, which were made effective July 26 to aid the distribution of coal during the emergency created by the current strike, will have a direct effect in interfering with the highway construction programs in many of the states. *Engineering News-Record* has secured the following comment on the probable results of the present transportation emergency:

A. R. Hirst, state highway engineer of Wisconsin, says that the Interstate Commerce Commission's priority orders will probably close down 50 per cent of road construction in that state. A few jobs have aggregate and cement enough on hand to last for six weeks. Sixty per cent of Wisconsin's concrete roads are built from road-side aggregate. Of this year's 440-mile paving program 200 miles are now completed. Anticipating the commission's orders Mr. Hirst has sent three warnings to contractors, the first one having been issued in May.

Frank F. Rogers, state highway commission of Michigan, says 75 per cent of work on that state's 250-mile paving program will close down; only 10 per cent is now completed. On one job it will be possible to haul aggregate and cement by truck.

Of Illinois' 1,000-mile program 240 miles are completed. Last week a record mileage of 37 was built. Illinois will be closed down more completely than Michigan. The flow of cement for the next six weeks, officials say, will be predicated on the supply of box cars.

In the absence of Thomas H. MacDonald, chief, U. S. Bureau of Public Roads, Capt. P. St. J. Wilson, chief engineer, estimated that the priority orders, if effective for a considerable period, would have a serious effect in curtailing road work, especially in the North and East. The effect, he pointed out, would be most marked in those states building high-type, hard-surfaced roads. Any car shortage would be serious, he said, not only in the case of concrete but also of bituminous construction, for in most of the states the supplies of asphalt and tar are not sufficient to tide over a long period.

Sesquicentennial Resolution Passes Senate

That Congress expects to appropriate liberally to the sesquicentennial exposition to be held in Philadelphia in 1926 was revealed during the discussion of the sesquicentennial resolution in the Senate recently. Though objection was made to the resolution, previously passed by the House, on the ground that to pass it would commit the government to participation without knowing how much expense it would entail, it finally was passed by the Senate.

Wm. Barclay Parsons Made Brigadier General

Col. William Barclay Parsons, commander of the 11th Engineers during the World War, has been promoted to the rank of brigadier general, O.R.C., and will continue to serve as deputy chief engineer, G.H.Q. organized Engineer reserve of the U. S. Army. Gen. Parsons is a native of New York City and a graduate of Columbia University, of which he is now chairman of the board of trustees. He has been associated with many engineering works of national importance. Among the foremost are the location of the Canton-Hankow R.R. in China, the International Advisory Board of Consulting Engineers for the Panama Canal, the Isthmian Canal Commission, the Royal Commission on London Traffic, the first New York subway, the Chicago Traction Commission and the Cape Cod Canal.

When the United States entered the World War, Gen. Parsons was major in the Engineer Officers Reserve Corps and was assigned as a battalion commander to the regiment that later became the 11th Engineers. Later he went to France in advance of the American army as senior member of a special commission to investigate transportation conditions there. Upon arrival of his regiment he rejoined it as lieutenant colonel and served with it throughout its stay in France. In the spring of 1918 he assumed command of the regiment and was made colonel during that summer. After the armistice, he conducted for the Peace Commission an investigation into the damage inflicted upon Belgian industry and railways by the German army of occupation. For his services in France, General Parsons was awarded the British Distinguished Service Order, the Crown of Belgium, and a citation for exceptionally meritorious and conspicuous services by the commander-in-chief, A. E. F.

In his new position, Gen. Parsons will take an important part in the organization of the Engineer section of the Officers Reserve Corps.

Senate Votes $100,000 for Study of Columbia Basin Project

The Senate has passed a bill authorizing the Secretary of the Interior to investigate the Columbia Basin irrigation project in the State of Washington, a report to be made by Jan. 1, 1924. An appropriation of $100,000 is provided for in the bill.

Drainage Congress in September

The National Drainage Congress will hold its eleventh annual meeting at Kansas City, Mo., Sept. 25 to 29, and an industrial exhibit is to be a feature of this meeting.

Second Delaware Bridge Caisson Launched

1,700-Ton Structure Takes Water At New York Shipbuilding Co. Yard. —To Carry Camden Pier.

The east or Camden pier caisson for the Delaware River bridge to connect Philadelphia and Camden was launched July 18 at the yard of the New York Shipbuilding Co., Camden, with entire success. The structure is of combination steel and timber construction, with steel working chamber, steel trusses staying its roof, and timber walls above the roof. The dimensions of the caisson are 70 x 143 ft., and its launching weight was about 1,700 tons. It was built in one of the covered building ways of the shipbuilding plant, on the normal launching slope, and was launched on two ways, being held by tie timbers at the inshore end which were sawed through to release it. Jacks were provided to start its motion, if needed, but the caisson started of itself when the timbers had been sawed part way through, tearing the wood. When afloat it drew 12½ ft.

Robert Moore, Former President of Am. Soc. C. E., Dies

Robert Moore, of St. Louis, who was president of the American Society of Civil Engineers in 1902-1903, died July 23, 1922, at a summer resort in Michigan.

Mr. Moore was born in Newcastle, Pa., June 19, 1838. He went to St. Louis in 1868 and was active in engineering practice in that city until his retirement about five years ago. He took a prominent place in the early engineering development of St. Louis and was a member of the first Board of Public Improvements, in which capacity he did much to establish the high standards which have been the objective of succeeding boards. He was especially interested in educational work and was for ten years a member of the Board of Education of St. Louis which, during his tenure, became one of the city's chief agencies for civic betterment.

Mr. Moore was a past president of the Engineers' Club of St. Louis and, at the time of his death, its oldest living member.

Complete Hazardous Blasting Over Transit Tunnel

Deepening of the channel of the East River, New York harbor, which has been in progress since February 1921, has just been completed in the section over and adjacent to the Clark St. tunnels of the Interborough Rapid Transit Co. As the bed of the river at this point is of ledge, unusual precautions in blasting were necessary to avoid damage to the tunnels, which lie in places less than 30 ft. below the new grade of the channel.

No blasting was permitted during the morning and evening rush hours for tunnel traffic; and a carefully organized system of signalling and inspection was established whereby no blast was fired while a train was passing through. The work is being done by the New Jersey Shipbuilding and Dredging Co., under the direction of Col. Edward Burr, U. S. District Engineer. Chairman McAneny of the Transit Commission has written to the secretary of war to express appreciation of the care taken by Col. Burr to safeguard the traveling public.

EAST MAIN PIER CAISSON LAUNCHED FROM WAYS OF NEW YORK SHIPBUILDING CO., CAMDEN, N. J.

With a ground plan of 70 x 143 ft., the caisson covers a quarter acre of ground. It was built up to a height of 72 ft. at the time of launching; a cofferdam section will be bolted on top later. The caisson shell is timber, but the working chamber and its roof trusses are steel. A false bottom reduced the water impact in launching.

As launched, the caisson had a loose false bottom under the working chamber, to make it enter the water more smoothly and prevent impact against the four transverse bulkheads which divide the working chamber. This false bottom was pulled out from beneath shortly after launching. The interior of the caisson above the working chamber was found entirely dry.

Dredging the pier site to about 35-ft. depth was completed on July 28 and the caisson was towed to place and entered between guide piles ready for concreting to settle it on the bottom. The sinking will go through silt and gravel as on the Philadelphia side, but a layer of clay will also have to be passed through, and rock will lie somewhat deeper than on the Philadelphia side, according to the borings.

The Philadelphia pier substructure is now nearly complete; the work of setting granite for the pier facing is just being started. The construction of this foundation went on rapidly and without interruption or incident. Bids having been received Dec. 19, 1921, a contract for the two piers was signed on Dec. 27 with Holbrook, Cabot & Rollins Corp., who let a subcontract for the construction and launching of the caissons to the New York Shipbuilding Corporation shortly afterward. The Philadelphia caisson was launched April 24 and delivered at the pier site May 6. Concreting started May 9, and the caisson reached the river bottom at El. —42 about two weeks later. Air pressure was put on May 26, and excavation then continued through mud, gravel, and decomposed rock until June 20, when the cutting edge was stopped. Rock was first struck 10 ft. below the dredging plane, or at El. —52 (Philadelphia datum is 2.43 above mean high water), but the caisson was sunk to El. —60.5. Excavation below the cutting edge continued in one place as much as 11 ft. On June 20 concreting in the working chamber was begun, and the chamber was all sealed by July 1, and air pressure was removed on July 3. The highest pressure used during the work was 28½ lb.

Concreting was carried up to El. —12.5, at which level the granite is to start. The material for the pier facing is Georgia granite from the quarry of the Stone Mountain Granite Corp., and much of it is on hand and ready for placing.

Plan to Connect Bayonne and Staten Island

An appropriation of $10,000 has been made by Hudson County, N. J., toward the preliminary engineering expenses for a bridge or tunnel crossing the Kill von Kull, to connect Bayonne and Staten Island. The appropriation is made with the proviso that New York authorities appropriate a similar sum. A crossing at this point has been under discussion for many years. The last definite action concerning it was a report on a bridge crossing at this point by an interstate bridge commission ten or twelve years ago.

International Housing Congress for Rome in September

An International Housing Congress is to be held in Rome, Italy, Sept. 21-26 inclusive. The Congress will deal with all matters pertaining to the housing problems of the various countries, especially as regards inexpensive houses. The Italian executive committee of the congress has decided to publish a fortnightly bulletin dealing with questions which will be discussed in September.

Los Angeles Seeks San Joaquin Power Site

At a hearing held in Bakersfield, Cal., June 15 and presided over by F. H. Fowler, district engineer for the U. S. Forest Service, and H. A. Kluegel, chief engineer of the division of water rights, state department of public works, were heard and protested the application of the City of Los Angeles to establish two reservoir and power plant sites on the south fork of the Kern River in Tulare County.

Los Angeles proposes to construct one reservoir, conduit and power plant above Monache meadows and a second reservoir, conduit and power plant at Rockhouse. The Monache reservoir would have a capacity of 25,000 acre-ft. and would flood 1,700 acres of land. The diversion from the reservoir to the power plant would be made by an open and closed conduit 10 miles long from the east bank of the river, ending in a steel penstock 1.8 miles long. The static drop from tunnel to power-plant turbines would be 1,728 ft. The Rockhouse project consists of the construction of a dam 92 ft. high and 1,350 ft. long, to store 26,000 acre-ft. of water which would flood 714 acres. Diversion would be by a tunnel 9.8 miles long, closed except for 2,500 ft. where the conduit would pass over a stream. The penstock would be 1.56 miles long.

The protestants to the plan, comprising practically every public organization of the San Joaquin Valley, contended that the storage projects planned by Los Angeles could not be carried out without interfering with prior water rights. According to the Hagen-Carr agreement of 1888, the flow is measured at two points on the river during six months of the year, the period of measurement beginning March 1 and ending Aug. 31. Three hundred second feet of the flow at the first point of measurement are diverted for irrigation purposes and the remainder is delivered at the second point of measurement, also for irrigation service. Buena Vista Lake was constructed to receive this "second point" water. The Los Angeles storage plan, according to the protestants, would cut the pro rata of water due "second point" farmers, and would deprive the San Joaquin Valley of the full utilization for power purposes of streams flowing into it from nearby mountains.

To Remove Colorado River Raft

According to the terms of a bill recently introduced in Congress the Secretary of War will be directed to have a survey made of the Colorado River in Texas with the view to removing the great raft that has been forming in Matagorda and Wharton counties, as well as controlling flood waters of the stream under the flood-control act of March 1, 1917. The plan contemplates that government engineers will take charge of the work with such federal aid as may be secured, and with consent of the people of those localities, a few counties to be exempt from state taxation to finance the undertaking further as was done in improvements at Galveston.

The great raft referred to extends up the river for about 60 miles and accumulates at a rate of a mile a year. It is now within 15 miles of Wharton.

The Engineer in Public Life

ARTHUR M. SHAW

In activities affecting the development of New Orleans, Arthur M. Shaw, consulting engineer, has taken a prominent part. For many years he has been identified with the New Orleans Association of Commerce, having served as chairman of its health and sanitation committee and as member of its port facilities and city planning committees. During 1919 and 1920 Mr. Shaw was active in the Child Welfare Association and served as chairman of that body's committee on city sanitation as affecting infant welfare. Mr. Shaw now occupies the post of dean of the School of Engineering at Loyola University, after a professional experience of thirty years in railroad, reclamation, drainage, and municipal work.

Born in Lee Center, Ill., in 1870, he studied civil engineering at Cornell College, Mt. Vernon, Iowa, and in 1891 was engaged as rodman and instrumentman on railway location and construction. During the Spanish-American War, in 1898, he served with the second U. S. Volunteer Engineers as corporal and sergeant. After a period with the Illinois Central R.R., beginning in 1903, he went to Mexico in 1906 as division engineer in charge of the new line of the Mexican International Ry. from Durango to Guadalajara. He returned to the United States in 1908 and specialized on reclamation and drainage projects as consulting engineer, with offices in New Orleans.

During the war, with rank of major, he was in charge of several army-camp construction projects. In addition to his university work, Mr. Shaw engages in private practice at New Orleans, specializing in railway location, land reclamation, and sanitary work. Last year he completed a sanitary survey for the city of San Pedro Sula, Honduras. He is a past-president of the Louisiana Engineering Society and of the Louisiana Section of the American Society of Civil Engineers.

High-Voltage Power Line Built at Purdue

An experimental transmission line for operation at 600 kilovolts, the highest voltage power line in the world, has recently been completed at Purdue University, Lafayette, Ind. The line is approximately a third of a mile long and consists of three 600-ft. strands of steel core aluminum cable which is supported on steel towers sixty-five feet in height.

The line is built to determine the possibilities of transmitting voltages in excess of 240,000 volts over considerable distances.

Affiliated Technical Societies of Boston Formed

Informal meetings held by representatives of the various technical societies in Boston during the past year to consider an affiliation of these societies has led to the organization of the Affiliated Technical Societies of Boston, which was granted a charter last month. The following nine societies are member organizations: Boston Society of Civil Engineers, New England Water Works Association, Plant Engineers' Club; Boston Section, American Institute of Electrical Engineers; Boston Section, American Society of Mechanical Engineers; Northeastern Section, American Society of Civil Engineers; Boston Section, American Institute of Mining and Metallurgical Engineers; Massachusetts Chapter, American Society of Heating and Ventilating Engineers and the Boston Chapter, American Association of Engineers.

The council of the association, which is composed of two representatives from each affiliated organization, has elected the following officers: Leonard Metcalf, chairman; Alfred S. Kellogg and Alexander Macomber, vice-chairmen; Charles L. Hammond, treasurer; W. G. Starkweather, clerk; and J. B. Babcock, executive secretary.

An agreement has been made with the Boston Society of Civil Engineers for the use of its quarters, library and equipment and a similar agreement has been made with the New England Water Works Association, whose quarters adjoin those of the Boston Society.

A. G. C. Issues Agreement Form for Rented Equipment

An equipment lease that constructors are willing to sign as either lessee or lessor has just been issued by the Associated General Contractors of America. Its object is to provide a simplified rental agreement which will insure absolute fairness to both parties. The form adopted is the result of investigations and criticism of members of the A. G. C. extending over a period of two years. It was prepared under the direction of the Committee on Methods, of which A. P. Greensfelder, secretary of the Fruin-Colnon Contracting Co., St. Louis, was chairman, and Ward P. Christie, research engineer. Through use of this form it is believed that many difficulties incident to renting construction equipment can be eliminated.

Civil Service Examinations

UNITED STATES

For the United States civil service examinations listed below apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Civil Service Commission.

Vacancies in the office of the Supervising Architect, Treasury Department. Computer and estimator, $1,600 to $1,800 per year. Examinations Aug. 23 and 24.

Vacancies in the Public Health Service. Junior assistant sanitary engineer and assistant sanitary engineer, $2,320 and $3,225, respectively, per year. Examinations Aug. 9.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

ENGINEERING INSTITUTE OF CANADA, Montreal, Que.; Professional Meeting, Winnipeg, Man., Sept. 5-7.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston; Annual Convention, New Bedford, Mass., Sept. 12-15.

AMERICAN ASSOCIATION OF PORT AUTHORITIES; Montreal, Que.; Annual Convention, Toronto, Ont., Sept. 14-16.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Cleveland, Ohio, Oct. 2-6.

The San Francisco Section, Am. Soc. C. E., devoted the regular meeting on June 20 to an informal discussion of the investigation of California's water resources now being conducted under the direction of the state department of engineering with a $200,000 appropriation made by the latest state legislature. Among those who participated were John D. Galloway, A. E. Chandler, T. H. Means, C. H. Lee and Col. R. B. Marshall. All who spoke favored a complete study of water resources before laying out any state development program and the speakers frequently referred to the dangerous features of the proposed $500,000,000 state water and power bill. Water development has already been carried beyond immediate needs in California, it was said, and the more pressing requirements are now more settlers on land already under irrigation and the education of irrigators, particularly in the dangers of water logging. Moving pictures of the parent society meeting at Dayton were shown.

PERSONAL NOTES

HOWARD S. REED has been appointed city engineer of Phoenix, Ariz. Mr. Reed was for a number of years in the employ of the U. S. Reclamation Service, being attached to the engineering staff working on the construction of the Roosevelt dam. Since 1913 he has been associated with Sheldon K. Baker in private practice in Phoenix.

C. G. PAYNE has been approved as county engineer of Meade County, Kansas, by the State Highway Commission. Mr. Payne was formerly county engineer of Johnson County.

BRIGADIER-GENERAL T. L. TREMBLAY has succeeded St. George Boswell, resigned, as chief engineer of the Quebec Harbor Commission.

C. F. HINCHMAN has been appointed division engineer of maintenance-of-way of the Springfield division and Indianapolis terminal of the Cleveland, Cincinnati, Chicago & St. Louis Ry., with headquarters at Indianapolis, Ind.

DR. J. A. L. WADDELL, consulting engineer, New York City, has been elected a member of the Royal Academy of Sciences and Arts of Barcelona, Spain.

ROY W. ELLIOTT has resigned as instructor in civil engineering at the University of Michigan, and has accepted the position as superintendent of buildings and purchasing agent for the board of education at Topeka, Kans.

H. A. KUEHMSTED, former assistant engineer of the San Diego and Arizona R.R., has been appointed engineer of way and structures of the San Diego Electric Ry.

COL. GEORGE M. HOFFMAN, Corps of Engineers, U. S. Army, has been nominated by the United States Senate as a member of the Mississippi River Commission.

ARVID SJOVALL, formerly assistant city engineer of New Britain, Conn., has recently become associated with the public-works contracting firm of Edward Balf Co., Hartford, Conn.

MAJOR RAYMOND A. WHEELER, on duty at Fort Benning, Ga., it is expected, will be detailed as assistant engineer commissioner of the District of Columbia, succeeding Major Cary Brown, whose orders transferring him to Camp Humphreys, Va., have been issued. Recommendation for Major Wheeler's appointment has been made at the War Department and it is expected he will assume the office August 1.

OBITUARY

ANTHONY C. DOUGLAS, who was one of the contractors on the construction of the tunnel through Bergen Hill at Jersey City for the Delaware, Lackawanna & Western R.R., died recently at Niagara Falls, aged 67 years. Mr. Douglas also had some part in the construction of the Croton dam for the water supply of New York City, as well as the construction of the first Niagara Falls power tunnel. Mr. Douglas was mayor of Niagara Falls from 1907 to 1911.

JOHN W. MORRIS, who, associated with J. H. Strobridge, took considerable part in the construction of the Central Pacific and the Southern Pacific Railroads, died recently in Oakland, Cal., where he had lived for the past 65 years. He was 94 years of age. Mr. Morris was born in Pennsylvania but went to California in 1852.

LUTHER WAGONER, consulting engineer of San Francisco, whose professional career carried him into practically every line of engineering and into many countries outside his own, died in San Francisco July 1. Outstanding in his professional career were his positions as chief engineer of the Havana sewer and paving contract, a position to which he was appointed by President Menocal of Cuba in 1916; his journey to Europe in 1907 in a semi-official capacity to study harbor improvements; and his joint authorship of a plan for the complete development of the San Francisco harbor. Mr. Wagoner had been engaged in engineering work since 1866 when he served for a short time as deputy county engineer of Johnson County, Mo. In 1866 he entered the service of the Union Pacific Ry., leaving it to become engineer of the land department of the Texas Pacific. From 1874 to 1877 he was in Brazil on bridge construction, geodetic work and mine development and in 1879 was engaged in water-supply work in Kansas. In 1884 he had charge of the construction of a section of the San Francisco sea wall.

After four years in a general mining engineering practice, from 1896 to 1900, he was given charge of the investigation for a new water supply for San Francisco. In the intervening time he had made plans for the reclamation of Colusa Basin in California and also for dams, canal systems, reservoirs and other irrigation work in various western states. He was past-president of the Consulting Engineers of the Pacific Coast, of the San Francisco chapter of the American Society of Civil Engineers, and a member of several other technical organizations.

BUSINESS NOTES

A. A. MURPHY has recently been appointed New York City sales manager of the industrial and railway paint and varnish division of E. I. Du Pont De Nemours & Co., Inc., Wilmington, Del.

THE YOUNGLOVE CONSTRUCTION CO., Sioux City, Iowa, has been appointed representatives for the Conveyors Corporation of America for the sale of American trolley carriers in northwestern Iowa and in South Dakota.

THE BINGHAMTON ENGINEERING CO. has recently been organized at Binghamton, N. Y. The company specializes in the design, fabrication and erection of structural steel work. A. L. Gilmore is the president of the concern and George H. Young is treasurer.

R. P. RAYNSFORD, for the last three years chief engineer of Lockwood, Greene & Co., of Canada, Ltd., on September 1 will join the organization of the Canadian Consolidated Rubber Co., Montreal. He succeeds Frank W. Harding, consulting engineer of Footwear Factories, who is retiring after over 25 years of service.

BEAR TRACTORS, INC., New York City, has announced an increase in field-sales force. CLARENCE STANTIAL, formerly with the Cleveland Tractor Co., will represent the Bear company in the East; W. A. INGALLS, for several years covering northwestern territory for the Hart-Parr Co., will represent the Bear company in that territory; and L. G. MELROSE, former president of the Kirkwood Automobile Co., Kirkwood, Mo., will operate in southwestern territory from headquarters in St. Louis.

EQUIPMENT AND MATERIALS

End-Opening Pipe Wrench

Only three parts, a handle and jaw in one piece, a movable jaw, and a hardened steel nut, are employed in the Little Giant pipe wrench which has

just been put on the market by the Greenfield Tap & Die Corp., Greenfield, Mass. The wrench has the end-opening feature and among the advantages claimed for it is the ease with which it can handle pipe in corners, close to walls, and in other confined places. The pipe may be set straight on the pipe, like a pair of pliers, without the necessity of fitting the jaws on from the sides. The handle and jaws are drop-forged and heat-treated and all such parts as springs, rivets, frames or pins have been eliminated. The wrench is manufactured in 8, 10, 14, 18, and 24-in. sizes. The 14-in. size, the manufacturers state, has repeatedly withstood stresses in excess of 47,000 in.-lb. without slipping or bending.

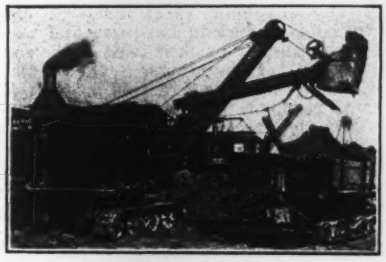
Crawler Crane

To the line of construction plant manufactured by the Link Belt Co., Chicago, has been added a crawler crane mounted on caterpillar treads and with a lifting capacity of 10 tons at 12-ft. radius and 3 tons at 30-ft. radius. Equipped with two independent hoisting drums the machine is suitable both for clamshell and dragline work. Without the bucket the crane weighs approximately 22 tons and exerts a pressure on the ground of 10 lb. per square inch. Power is furnished by a four-cylinder Climax gasoline engine operat-

ing at 800 r.p.m. The boom is 35 ft. long and is made of angle and lattice bar construction. With the exception of the slow-running 7-ft. rotation gear and pinion, all gears, including spur, bevel and worm, have machined teeth cut from solid blanks of steel or bronze. The manufacturers make a point of the fact that there are only 16 gears of all descriptions as against about 30 gears in other types of locomotive crane. If desired, a 40-hp. electric motor may be substituted for the 50-hp. gasoline engine with which the crane is ordinarily equipped.

A ¾-Yd. Universal Shovel Replaces Old Type

A number of new and improved features are incorporated in the 20-ton, ¾-yd. revolving shovel (Type 20-B), which the Bucyrus Co., of South Milwaukee, Wis., has developed to replace its Type 14-B revolving shovel. The new machine is adapted to dragline, high lift, clamshell, crane and other combinations. Among the innovations in its design are the use of a two-part instead of a three-part hoist to facilitate the use of the equipment for dragline work; outside type of dipper sticks and box-girder type of boom as a stronger form of construction than that formerly employed; A-frame directly connected to a steel center casting to



form a more solid support; rounded corners on the dipper which facilitate the dumping of sticky material; an improved and simplified three-lever control.

Rotary Snow Plow

At Big Creek, in Fresno County, Cal., last winter the state highway commission experimented with a rotary snow

plow on a mountain highway where the grades average 14 per cent and the depth of snow varied from 12 to 14 ft. According to a report by J. C. Woodson, division engineer, the highway rotary snow plow can be operated successfully where grades are not excessive and in freshly fallen snow up to 5 or 6 ft. in depth. The California Edison Co. also used last winter a snow plow manufactured by the WINTHERS MOTOR CO. of Kenosha, Wis., photograph of which is reproduced herewith. The results indicated that the plow is effective in snow that has not been allowed to pack or freeze. It is understood that the Winthers company is redesigning parts of the plow preliminary to further tests.

Out-of-the-Ordinary Trade Publications

Blasting — THE HERCULES POWDER CO., Wilmington, Del., has issued a 48-page booklet, illustrated with drawings and photographs, entitled "Eliminating Waste in Blasting." The text is by N. S. Greensfelder and presents information of technical value to both engineer and contractor. . The various operations involved in tunneling and quarrying operations are analyzed and time records given for each step for a 16-hole round. A chapter on "Drilling" gives sketches of drill-hole arrangement and data based on studies at the Copper Queen mine. The information deals with such matters as the proper inclination and spacing of drill holes and their length in rocks of different character. A number of valuable points based on experience gained in driving the tunnel for the Hetch-Hetchy water supply system for San Francisco are made. Several pages are devoted to the choice of explosives under various conditions and their best distribution in loading drill holes. Data on firing systems include both fuse and cap and electric firing. The booklet is not a trade catalog but a compilation of practical information drawn from many sources.

Rotary Snow Broom — THE FOX ROTARY SNOW BROOM CO., Newark, N. J., in a 12-page illustrated pamphlet, sets forth the features of its device for clearing snow from country highways and city streets. The broom, which can be mounted on any standard motor-truck chassis, is an adaptation of the street-railway broom sweeper. It operates most economically at a speed of 12 miles per hour (400 r.p.m.) in snow 10 in. deep, cutting a swatch 9 ft. wide.

Excavator and Loader—THE T. L. SMITH CO., Milwaukee, is distributing a four-page leaflet dealing with its excavator and loader comprising a drag-line scraper delivering into the pivoted frame of the machine which elevates and dumps the material into motor trucks. In basement excavation the loader remains at the surface requiring, besides the operator, only one man in the hole. It is also used for sand and gravel pit work and for grading.

Motor Trucks—THE ATTERBURY MOTOR CAR CO., Buffalo, N. Y., has issued a 16-page illustrated booklet giving specifications for its 1½, 2½, 3½ and 5-ton motor trucks together with detailed description of the mechanical features of this equipment.

Copper Roofing — The Copper and Brass Research Association, New York City, has published a 29-page book of information for engineers, architects and roofing contractors regarding the use of copper roofing. After stating some general facts about copper, the text gives a table of comparative weights of various roofing materials, 16 oz. (standing seam) copper weighing 125 lb. and copper shingles from 84 to 100 lb. per 100 sq.ft. laid. The two methods of applying copper sheets to sloping roofs, the "ribbed seam" and the "standing seam" methods are described. In addition, certain fundamental considerations in sheet-copper roof construction are stated, with particular attention to flashings, gutters and eaves troughs. A condensed specification for copper roofing is given and there are four pages of drawings showing all sorts of copper roofing details.

Business Side of Construction

Facts and Events that Affect Cost and Volume

1913 Should Be Retained as a Price Base

E. E. George Estimates Future Price Trend as Perhaps 2 Per Cent a Year

E. E. George, of the Valuation Division of the Department of City Transit, Philadelphia, is convinced that the pre-war bases should be maintained. "The pre-war base for index numbers is now practically an international standard," he writes *Engineering News-Record*, "and although many new index numbers have been designed only within the last few months, especially for the smaller countries, most of them have been referred to 1913 or 1914 as 100 per cent.

"The United States Department of Commerce, the Bureau of Labor Statistics and the Federal Reserve Board all use 1913 as 100. The Reserve Board has recomputed practically every existing index number to the pre-war basis, where the same has not already been done by its authors. Furthermore, the Harvard Economic Service and other statistical services base most of their charts and index numbers on the year 1913

"While there is a general opinion that the new normal level of prices will be about 50 per cent above pre-war, it should be noted that this level is effective only for "All Commodities." The cost of living, the prices of metals, rentals, construction costs of simple structures, and many other important price levels that are currently measured, are far from approximating 50 per cent above the pre-war figures.

"Furthermore, there is no certainty that these index numbers will approach the figure for "All Commodities." The Harvard Economic Service has made a study of the long term trends of prices for the different classes of materials, and finds that the trend of metal prices is downward, while that of food products is upward. Therefore any new normal can only be effective for a single kind of index number, and any shifting of the base only confuses the observer who has been accustomed to the 1913 reference points.

"The future tendency of prices over a long period of years is a highly debatable subject on which the best economists are not agreed. One of the foremost authorities went so far as to say that any man risks his reputation who prophesies on the subject. It is, however, fairly well agreed that the trend up or down will be relatively slight, say not over 2 per cent a year. Of course, due to depressions and booms, the business cycle will cause larger annual changes than 2 per cent, but these are of a periodic or recurrent nature and may be ignored in studying the long-time trend.

"It seems to be generally agreed that there is a fairly definite international price level when foreign trade is normal, and that in any study of the future trend of prices here, one must consider the financial policies of Europe as well as of this country."

Hollow and Common Brick Take Same Tariff Rate

As a result of an opinion by the board of general appraisers, hollow building-brick takes the same rate of duty as does the ordinary brick of commerce. "The ordinary brick of commerce," says the opinion, "is a rectangular block of clay burned in a kiln, the length generally being twice the breadth; but neither the shape nor the dimensions are the essentials of a brick. The brick known to the tariff law is any article of any shape or form made of clay burned to a certain hardness and used as the ordinary brick is used in the construction of buildings. The article which is the subject of this protest, we think responds to this definition."

Despite its greater value, hollow building brick, therefore, may be imported on payment of a duty of ten per cent ad valorem, the rate applicable to ordinary bricks.

Landis Award Workers in Chicago Reach 16,000

Recent attempts on the part of international building trade heads to "settle" the building situation in Chicago with the Landis award committee so that the members of the thirteen outlaw unions might obtain employment have not been successful. More than 16,000 men are now working in the outlaw trades for Landis Award contractors. Since the first of the year $80,000,000 worth of building permits have been taken out in Chicago for work by these contractors. Building activity especially in apartment houses has slowed up materially. For the first two weeks in July compared with the second two weeks period in June the number of permits dropped from 590 to 458 with values nearly two-thirds less. According to *Chicago Commerce*, the journal of the Chicago Association of Commerce which has staunchly backed the Landis award and the committee, all building contracts awarded during the week of July 15 were taken by Landis award contractors. F. W. Armstrong, general manager of the citizens' committee, states that much of the speculative building is over as rents are dropping and returns are less than anticipated. This fact will give some relief to the Landis award contractors on larger buildings who have been handicapped by a shortage of mechanics in the pro-Landis closed-shop trades.

Coal Cars Short in West Virginia

Freight loadings for the week ending July 8, totalled 718,319 cars, according to the American Railway Association. This is a reduction of 158,577 as compared with the week ending July 1, but an increase of 77,784 over the corresponding week in 1921.

Scarcity of cars for grain loading is beginning to make itself felt in the Middle West, while an actual shortage of coal cars is reported in West Virginia fields, where only about 75 per cent of the normal supply of surplus cars are now available for coal.

1913 Prices Will Never Be Reached in Many Lines

W. S. Bartholomew Believes Buyers at Present Would Be Satisfied With a 150 Level

W. S. Bartholomew, vice-president of the Westinghouse Air Brake Co., gives *Engineering News-Record* his views of the business situation with particular regard to prices. "As far as our own experience is concerned," he writes, "we are able to make prices on but one basis, namely, from proper relation to cost of production. This basis is not always acceptable to the buyer for the reason that a purchaser adopts ways and means for figuring out what prices ought to be according to trends and averages which often times do not square with the actual cost at the time. This brings very unfortunate complications.

"In recent months, a great effort has been made by everybody, and it has been highly commendable, to encourage resumption of purchasing, especially by the transportation companies both electric and steam. In a great many cases the manufacturer's contribution in the matter of lower prices has been without regard to cost of production or cost of material on hand, and used in filling orders which came from this united effort. We are, therefore, apt, under such circumstances, to strike a mark in the readjustment of price levels which is not justified by the facts as far as the selling prices being in proper relation to costs is concerned.

"It is our opinion that actual price levels of 1913 will never again be reached in many industries. There are various reasons for this which are too complicated to explain in a letter.

"It is also our opinion that buyers generally would be well satisfied at present if a level were reached which was approximately 50 per cent above 1913 prices.

"Further, we believe that the exact point of the price level does not cause as much concern to the buyer as does the question of the price being the lowest price obtainable at the time or in the reasonably near future; that is to say, the matter of first consideration to a buyer is not what the price is but whether it is the lowest price obtainable for his immediate needs in connection with transaction in hand. This leads to the conclusion, therefore, that stability of prices is more important than any price-level relationship with other price levels.

"The main consideration in securing stability of prices is, of course, continuity of production which can be secured only through general resumption of buying. This point has not as yet been reached and, therefore, there may be some further recession in prices in order to induce such resumption of buying to secure the continuity of production which will bring stability."

Next week—Index numbers, full list of prices, labor rates.

Production Briefs

Coal output dropped to present weekly rate of 5,000,000 to 6,000,000 tons below normal.

Connellsville Coke increased 10,000 tons during week ending July 20.

Crude Oil increased 24,000 bbl. daily in past two weeks.

Alabama pig-iron totaled 189,101 tons during June as against 93,000 tons in June, 1921; an increase of nearly 100 per cent.

Zinc supply down to only 29,576 tons, or less than one month's requirements. Shipments during first six months exceeded production by 37,032 tons.

Automobile production, including both passenger vehicles and trucks, exceeded 288,000 cars during June; an increase of 12 per cent over May, 1922.

New York Central R.R. placing orders for new equipment to cost over $36,000,000; Baltimore and Ohio, ordering 500 fifty-ton gondolas. Improvements and new equipment on other roads will exceed $150,000,000 for 1922.

Mexican Petroleum advanced 25c.; Eastern, South Western and Pacific crude oils down 50c. per bbl. during past week.

Gasoline down 1c. in New York and 2c. per gal. in Middle West, during week.

The price question—has many interesting components:

Will "future" prices be lower or higher than present?

Next summer—how much lower? How much higher? How about five years from now?

Will prices ever return to the 1913 level? If not, ought pre-war schedules be forgotten and a "new normal" be considered?

Professor Irving Fisher *thinks "the new normal is a delusion and a snare."—See Business Side of Construction, June 15, p. 1018.*

I. F. McDonnell *believes future trend will lie between 1914 trend and the declines following other wars.—July 13, p. 86.*

D. L. Bissell *holds that future wholesale prices will agree with per capita money circulation.—July 20, p. 126.*

W. S. Bartholomew *and* E. E. George *are speaking today.*

Engineering News-Record *believes that the price trend over the next few years will largely determine the degree of prosperity which* all industry *will enjoy or may not enjoy. For this reason it has invited an expression of opinion by the authorities mentioned and by other eminent authorities who have not yet spoken in these pages.*

Study of these opinions should be helpful in planning expansion.

Fifty Big Contracts Since March Total $81,960,860

Of These, Building Construction Leads —Industrial Works Next—Excavating and Dredging Third

From time to time *Engineering News-Records* is requested to publish a list of large contracts recently let or actually under way. Such a list, of twenty-six important jobs awarded in February and March, was published in the Searchlight Advertising section of the April 20 issue.

The accompanying table shows fifty big projects placed under contract since March and representing a total value of $81,960,860, 75 per cent or $61,921,900 of which was for building construction alone. Industrial expansion stood second with $9,900,000 or 12 per cent, and excavating and dredging follows with $1,142,145 or 1 per cent of the total for these fifty contracts.

Only three sewers, one railway and a single big bridge job are included in large projects let during the last three months.

The biggest job listed in these classifications is a twenty-one story bank and office building, in Cleveland, O., valued at $10,000,000. This project, together with two others in the Middle West representing a combined value of $11,304,828, or 14 per cent of the total value of the fifty contracts, is being constructed by New York contractors.

ESSENTIAL DATA ON LARGE CONTRACTS AWARDED SINCE MARCH

Place	Work	Size	Price	Successful Contractors
Cal., Berkeley	Hotel		$1,000,000	Lindgren & Co., Monadnock Bldg., San Francisco, Cal.
Cal., Live Oak	Ditching	380,000 cu. yd.	140,000	Ajax Dredging Co., 249 1st St., San Francisco, Cal.
Cal., Oakland	Office and bank	16 stories	1,000,000	P. J. Walker Co., Monadnock Bldg., San Francisco, Cal.
Cal., San Francisco	Store and lofts	8 stories	500,000	Foundation Co., Holbrook Bldg., San Francisco, Cal.
Conn., Hartford	Factory	4 story, 80x400 ft.	500,000	R. G. Bent Co., 183 Ann St., Hartford, Conn.
Conn., New Haven	Office	12 story, 64x90 ft.	750,000	C. W. Murdock, Inc., 505 Grand Ave., New Haven, Conn.
Conn., Thompsonville	Mill		1,000,000	L. E. Locke & Sons Co., South Union St., Lawrence, Conn.
D. C., Washington	Hotel	8 stories	1,500,000	Weed & Stanton, 918 F. St., Washington, D. C.
Ill., Chicago	Printing plant	6 story, 170x177 ft.	700,000	R. F. Wilson Co., 1851 Elston Ave., Chicago, Ill.
Ill., Chicago	Hotel	10 story, 137x150 ft.	1,500,000	B. W. Construction Co., 10th and South La Salle St., Chicago, Ill.
Ill., Chicago	Theatre		1,500,000	Van Etten Bros., 11055 South Michigan Ave., Chicago, Ill.
Ill., Chicago	Hotel	19 story, 120x210 ft.	3,000,000	McLennon Construction Co., 400 North Michigan Ave., Chicago, Ill.
Ind., Ft. Wayne	Office		1,000,000	Hageman-Harris, 95 Madison Ave., New York, N. Y.
Ind., Indianapolis	Office	17 story, 100x112x130 ft.	1,225,000	Bedford Stone & Construction Co., Fletcher Savings & Trust Bldg., Indianapolis, Ind.
Ia., Boone	Excavation		215,945	McHose Sand & Tile Co., Boone, Ia.
Ia., Des Moines	Office	12 story	1,000,000	A Benson Contracting Co., 422 Valley National Bank Bldg., Des Moines, Ia.
Kan., Spring Hill	Railway	13 mi.	45,000	Walsh Construction Co., 114½ West 3rd St., Davenport, Ia.
Me., Springvale	Mill and storehouse	5 story, 240x280 ft.	700,000	W. M. Bailey Co., 12 Salem St., Boston, Mass.
Mass., Boston	Hotel	10 story	5,000,000	Boyle-Robertson Construction Co., 601 Evans Bldg., Washington, D. C.
Mass., Boston	Office	11 story	6,000,000	W. A. & H. A. Root, 6 Beacon St., Boston, Mass.
Mich., Detroit	Sewer		304,328	Booth & Flinn, Ltd., 17 Battery Place, New York, N. Y.
Mich., Detroit	Plant	6 story, 102x979 ft.	2,000,000	W. E. Wood & Co., 1805 Ford Bldg., Detroit, Mich.
Mich., Detroit	Office	10 story, 66x140 ft.	750,000	E. Winters Co., 752 Book Bldg., Detroit, Mich.
Minn., Redwood Falls	Ditching		119,000	New Ulm Drainage & Construction Co., New Ulm, Minn.
N. J., Jersey City	Sewer		2,124,525	Holbrook, Cabot & Rollins, 52 Vanderbilt Ave., New York, N. Y.
N. Y., Bear Mountain	Bridge	1,700 ft. long, 50 ft. wide	5,000,000	Terry & Tench, Grand Central Terminal, New York, N. Y.
N. Y., Brooklyn	Apartment	12 story	1,500,000	By day labor, M. Courland, 47 West 34th St., New York, Engr.
N. Y., Buffalo	Plant		2,000,000	Du Pont Engineering Co., Du Pont Bldg., Wilmington, Del.
N. Y., Cohoes	Excavation and dredging		600,000	By day labor, Sanderson & Porter, 52 William St., New York, Engrs.
N. Y., Long Island City	Apartments		1,250,000	Stone & Webster, 120 Broadway, New York, N. Y.
N. Y., Long Island City	Sewers		311,855	H. J. Mullin Construction Co., Inc., Jamaica Ave., Jamaica, N. Y.
N. Y., New York City	Apartment	15 story, 100x100 ft.	900,000	By day labor, R. Candela, 200 West 72nd St., New York, Engr.
N. Y., New York City	Hotel	15 story, 204x220 ft.	2,500,000	F. T. Ley, 19 West 44th St., New York, N. Y.
N. Y., New York City	Loft	12 story	750,000	Rheinstein & Hass, 21 West 40th St., New York, N. Y.
N. Y., New York City	Apartment	14 story	1,000,000	By day labor, G. F. Pelham, 200 West 72nd St., New York, Engr.
N. Y., New York City	College		1,000,000	Nugent Construction Co., Inc., 21 East 40th St., New York, N. Y.
N. Y., New York City	Hotel	17 stories	1,500,000	Longacre Engineering & Construction Co., Inc., 562 5th Ave., New York, N.Y
N. Y., New York City	Library		1,500,000	Hegeman-Harris, 95 Madison Ave., New York, N. Y.
N. Y., New York City	Bank and office	23 story, 90x115 ft.	2,250,000	G. A. Fuller, 949 Broadway, New York, N. Y.
N. Y., New York City	Office	20 stories	2,000,000	T. C. Desmond & Co., Inc., 26 Beaver St., New York, N. Y.
N. Y., New York City	Courthouse		4,139,000	G. A. Fuller, 949 Broadway, New York, N. Y.
O., Cincinnati	Clubhouse	11 story, 88x200 ft.	907,900	J. & F. Harig, 1240 Queen City Ave., Cincinnati, O.
O., Cleveland	Bank and office	21 story, 147x258 ft.	10,000,000	Thompson-Starrett Co., 49 Wall St., New York, N. Y.
O., Cleveland	Waterworks	20,000 ft., 6 in., steel mains	510,607	P. J. Connelly, Kent, O.
Pa., Philadelphia	Office	16 story, 69x163 ft.	2,500,000	P. H. Kelly Co., 173 Sansom St., Philadelphia, Pa.
Pa., Pine Grove	Generating plant	25,000 kw.	3,000,000	J. G. White Engineering Corp., 43 Exchange Place, New York, N. Y.
S. C., Charleston	Hotel	12 stories	1,000,000	J. W. Cowper, Oliver Bldg., Pittsburgh, Pa.
Tex., San Antonio	Temple		1,000,000	By day labor, R. H. Cameron, 116 Central Trust Bldg., San Antonio, Tex., Engineer
Va., Norfolk	Dredging	140,000 cu. yd.	67,200	F. E. Jones Dredging Co., National Bank of Commerce Bldg., Norfolk, Va.
Wash., Seattle	Office	6 story, 120x173 ft.	500,000	Grant, Smith & Co., Seattle, Wash.
Total			$81,960,860	

The heaviest lettings are in the Middle Atlantic States and include 43 per cent of the building construction, two of the three sewer awards, and the only large bridge job.

Three out of seven industrial projects are in New England, two in the Middle Atlantic States and two in the Middle West.

Excavation and dredging appears to be fairly well distributed with one contract in the Western, one in the Middle Atlantic, one in the Southern states and two west of the Mississippi. The single large railway project is in Kansas.

Chicago's Building Record Broken

Building records for Chicago since 1893 have been beaten by those of the first six months of 1922, according to a statement by the citizens' committee to enforce the Landis Award. The previous high record was in 1912, when the value of all structures erected amounted to about $110,000,000. But the total value of building permits from Jan. 1 to July 1, 1922, was $111,502,310, this six months period beating all previous yearly totals. Of this building development, the contractors backing the citizens' committee are said to be getting the greatest percentage, an analysis of contracts let between May 10 and July 7 showing the committee contractors to have 82 per cent of all work costing $25,000 or over. The figures were: Landis Award contractors $25,328,000; non-Landis contractors $5,485,000. Monthly records of Chicago building permits during 1922 show the steady growth of the Landis boom as follows:

Month	No. Permits	Value
January	457	$7,991,550
February	634	13,493,800
March	1,327	19,333,900
April	1,315	17,076,560
May	1,273	27,029,650
June	1,419	26,576,850

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of July 6; the next, on August 3.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	+$2.83	$3.65	$4.00	$2.68	+$2.95	$3.60	$3.10	$3.75	$3.75
Structural rivets, 100 lb	3.60	4.35	5.50	3.10	3.53	4.45	4.25	3.75	6.50
Reinforcing bars, ¾ in. up, 100 lb	+2.73	3.50	3.50	2.58	+2.85	3.67½	2.55	3.60	2.90
Steel pipe, black, 2½ to 6 in. lap, discount	61%	61.15%	45%	59½%	61.9–5%	46%	49.1%	53%	30.00
Cast-iron pipe, 6 in. and over, ton	50.80	—48.00	51.50	46.60	50.50	57.00	51.00	—52.50	50.00
Concreting Material:									
Cement without bags, bbl	2.40@2.50	2.50	2.25	2.05	2.29	2.90	2.71	2.90	2.78
Gravel, ¾ in., cu.yd	1.75	1.85	2.25	1.80	1.50	1.75	2.25	1.10	1.50
Sand, cu.yd	1.00	1.15	2.25	1.80	1.00	0.75	1.50	1.10	1.25
Crushed stone, ¾ in., cu.yd	1.75	1.90	2.73	1.60	2.25	3.50	2.25	3.00	2.00
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	+51.00@52.00	39.00	—38.00	—47.00	40.00	51.00	31.00	+23.50	47.00
Lime, finishing, hydrated, ton	15.80@16.17	23.00	25.00	18.00	29.00	24.00	22.00	24.00	21.00
Lime common, lump, per bbl	2.75@3.14½	1.80	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	23.50	11.00	11.15	11.00	+17@18	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.0758	.115	.0707	.086	.08	....	.11	.09
ollow partition tile 4x12x12, Hper block	.1112	.0758	.115	.0657	...,	.08	.108	.11	.08
Linseed oil, raw, 5 bbl. lots, gal	.93	.98	1.07	1.01	1.03	1.16	1.04	.86	1.04
Common Labor:									
Common labor, union, hour	.60	.35	.....	.80	.....	.50@.55	.56¼	.50@.60	.....
Common labor, non-union, hour	.44@.60	+.30	.25	.72½	.35@.50	.35@.50	.47½@.50	....	.25@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81¼c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed store quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5¾ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at pit.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.13 cents. Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.

Changes Since Last Week

Although a recent slackening of steel buying has been noticeable, slower freight movements and falling off in production have stimulated sudden demand for shipments on orders already placed. Steel shapes quoted at $1.70@$1.80, Pittsburgh, on new business. Some sales, however, still go through at $1.60 on special tonnages, but a maximum of $1.85 has been reached on shapes and bars and $1.90 per 100 lb. on plates, for immediate deliveries. Slight stiffening of mill prices reflected in advance of 15c. on shapes and bars in New York warehouses and 9c. per 100 lb. in Minneapolis.

Birmingham pig-iron market temporarily softer; quotations for third-quarter deliveries slightly lower. Atlanta reports reduction of $1 and Seattle 50c per gross ton on cast-iron pipe.

Advance of $2@$3 quoted on long-leaf yellow pine, base sizes, in New York; Douglas fir up $1 per M. ft. b.m. in Seattle. Dallas, however, in the face of increasing demand, quotes reduction of $1, and Chicago $2 per M. ft. on yellow pine structural timbers.

Linseed oil prices unchanged over week end, but general tendency of market is downward.

Wage rate of 30c. quoted on unskilled common labor in Atlanta as compared with 20c. per hr., formerly. Birmingham still retains the lowest wage schedule for unskilled building laborers, 15c.@20c. No other large city beside Birmingham maintains a rate lower than 30c. per hour.